THE

EMPORIUM

OF

ARTS AND SCIENCES.

VOL. 1.] SEPTEMBER, 1812. [No. 5.

No. 42.

ON SPONTANEOUS COMBUSTION.

(Continued from page 253.)

On the Spontaneous Ignition of Charcoal: by B. G. SAGE, *Member of the Institute, Founder and Director of the first School of Mines.**

MR. de Caussigni appears to have been the first who observed, that charcoal was capable of being set on fire by the pressure of mill-stones.

Mr. Robin, commissary of the powder mills of Essonne, has given an account in the Annales de Chimie, No. 35, p. 93, of the spontaneous inflammation of charcoal from the black berry bearing alder, that took place the 23d of May, 1801, in the box of the bolter, into which it had been sifted. This charcoal, made two days before, had been ground in the mill without showing any signs of ignition. The coarse powder, that remained in the bolter, experienced no alteration. The light undulating flame, unextinguishable by water, that appeared

* Nicholson, vol. 23. p. 277. From Journal de Physique, vol. 65. p. 423.

on the surface of the sifted charcoal, was of the nature of inflammable gas, which is equally unextinguishable.*

The moisture of the atmosphere, of which fresh made charcoal is very greedy, appears to me to have concurred in the developement of the inflammable gas, and the combustion of the charcoal.

It has been observed, that charcoal powdered and laid in large heaps heats strongly.

Alder charcoal has been seen to take fire in the warehouses, in which it has been stored.

About thirty years ago I saw the roof of one of the low wings of the Mint set on fire by the spontaneous combustion of a large quantity of charcoal, that had been laid in the garrets.

Mr. Malet, commissary of gunpowder at Pontailler, near Dijon, has seen charcoal take fire under the pestle. He also found, that when pieces of saltpetre and brimstone were put into the charcoal mortar, the explosion took place between the fifth and sixth strokes of the pestle. The weight of the pestles is 80 pounds each, half of this belonging to the box of rounded bell metal, in which they terminate. The pestles are raised only one foot, and make 45 strokes in a minute.

In consequence of the precaution now taken, to pound the charcoal, brimstone, and saltpetre separately, no explosions take place; and time is gained in the fabrica-

* [Messrs. Aikins must, I presume, advert to the above fact, in the following quotation from their Chemical Dictionary, vol. 1. p. 238. although their reference is made to No. 36 of the An. de Chimie. Ed.]

"The affinity of charcoal for oxygen is so considerable, that instances have been known of its undergoing spontaneous combustion by simple contact with the air. An occurrence of this kind took place at the powder mills of Essonne in France. (An. de Chim. 36. p. 93.) A large quantity of recently burnt charcoal had been ground in the usual manner, and was deposited in a large receptacle for future use; some days after, the door of the magazine being opened in order to remove a part of the charcoal, an extraordinary heat was perceived, and immediately a train of fire was observed spreading over the surface of the charcoal, and which was not extinguished without much difficulty."

tion, since the paste is made in eight hours, that formerly required four and twenty.

Every wooden mortar contains twenty pounds of the mixture, to which two pounds of water are added gradually. The paste is first corned: it is then glazed, that is, the corns are rounded, by subjecting them to the rotatory motion of a barrel, through which an axis passes: and lastly, it is dried in the sun, or in a kind of stove.

Experience has shown, that brimstone is not essential to the preparation of gunpowder; but that which is made without it falls to powder in the air, and will not bear carriage. There is reason to believe, that the brimstone forms a coat on the surface of the powder, and prevents the charcoal from attracting the moisture of the air.

The goodness of the powder depends on the excellence of the charcoal; and there is but one mode of obtaining this in perfection, which is distillation in close vessels, as practised by the English.

The charcoal of our powder manufactories is at present prepared in pots, where the wood receives the immediate action of the air, which occasions the charcoal to undergo a particular alteration.

---

*Spontaneous Decomposition of a Fabric of Silk.**

On the night of March 19th, 1802, during the session of Congress at Washington, Jonathan Dayton, one of the senators then attending from the state of New-Jersey, sustained a loss of a pair of black silk stockings in an uncommon manner. On undressing himself at bedtime, his stockings were the last of his garments which he took off. The weather being cold, he wore two pair,

* Medical Repository, vol. 5. p. 458.

the inner of wool and the outer of silk. When he stripped off the silk stockings, he let them drop on a woollen carpet lying by the bed-side; and one of his garters, which was of white woollen ferretin, fell down with the stockings. The under-stockings, on being pulled off, were thrown at some distance, near the foot of the bed. He observed, on separating and removing the silk stockings from the woollen ones, that there was an unusual snapping and sparkling of electric matter. But as he had been long acquainted with the appearance, it attracted but transient notice.

He fell asleep, and remained undisturbed until morning, when the servant entered to kindle the fire. The man observed that one of the leather slippers, lying on the carpet, and partly covered by one of the stockings, was very much burnt. Mr. Dayton then rose, and found that the leather over which the stockings had lain was converted to a coal. The stockings were changed to a brown, or what is commonly called a butternut colour. And although, to the eye, the stitches of the legs, and even the threads of their clocks, appeared to be firm and entire, yet, as soon as an attempt was made to touch and handle them, they were found to be wholly destitute of cohesion, their texture and structure being altogether destroyed. Nothing but a remnant of carbonic matter was left, except that a part of the heel of one of the stockings was not decomposed.

Though this destruction of the stockings took place during the night, when nobody saw the manner and circumstances of the process, yet there was evidence enough of the evolution of much caloric while it was going on: for every thing in contact with the stockings was turned to coal or cinder. Beside the slipper before mentioned, the garter was burned. It had fallen partly on the carpet, and partly on and between the stockings. As far as

it touched the stockings it was perfectly disorganized and carbonated, and immediately beyond that limit was as sound as ever. The part of the carpet, with its fringe, which lay between the stockings and the floor, was in like manner totally destroyed, just as far as it was covered by the stockings, and no farther. The wooden plank, which was of pitch-pine, was also considerably scorched; and beneath the place where the thickest folds of the stockings had lain, was converted to charcoal or lamp-black to a considerable depth. In throwing down the stockings when they were pulled off, it happened that about a third part of the length of one of them fell not upon the carpet, but upon the bare floor. This part of the stocking was decomposed like the rest, and the floor very much scorched where it had lain.

There was very little fire on the hearth, and the little there was, was eight or nine feet distant. The candle had been carefully extinguished, and stood on a table in another direction, and about equally distant. Indeed, no application of burning coals or of lighted candles could have produced the effects which have been described. It would seem that the combustion, if it may be so called, proceeded from a surcharge of anticrouon (caloric), or electron (electricity), in the silk, accumulated by means not well understood; and that, not being referable to any known external agent, it may, in the present state of our information, be termed spontaneous.

The substances chiefly consumed were leather, wool, silk, and resinous wood. The linen lining of the slipper was indeed destroyed as far as the leather it touched was destroyed. But where it did not come in contact, it escaped, and the fire showed no disposition to burn even the linen beyond the boundaries prescribed to it on the leather.

What is the theory of this phenomenon? With what

other facts is it immediately connected? Whatever men of science may determine on these points, one thing seems to be evident, that if spontaneous combustion can happen thus to bodies so little inflammable as leather, silk, and wool, that instances of its occurrence in bodies easier to burn are more frequent than is generally supposed.

---

*Ignition of a Carboy of Aquafortis.**

Sir—An extraordinary accident lately happened to my neighbour, Mr. Watts, chemist, in the Strand, which has excited the attention of several persons of his profession. I am anxious your ingenious readers should know some particulars respecting it; and if you will indulge me by inserting briefly an account of the affair, I shall feel obliged, as it might in future prevent a more serious evil.

Wr. Watts had taken into his premises, as usual, a carboy of aquafortis, and from some unknown cause, the following morning, his warehouse appeared to be on fire; there being a great quantity of smoke seen issuing from many parts of the building. On entering the apartment, the carboy was on fire, and more than half consumed. I saw the remains of the basket and straw taken into the yard. The air quickly revived the fire, and I have no doubt but I could very easily have blown it into a flame. Particular inquiry was made respecting the straw, and it appears to have been perfectly clean and new. There was no turpentine, or other inflammable spirits, within a foot of the spot where the carboy stood; and it has very much surprised all who have seen it, how the acid could ignite such materials without the aid of other agents. Perhaps some of your scientific cor-

* Tilloch, vol. 36. p. 234.

respondents can assign a cause for this strange event, which does not appear to be generally known, and may point out a remedy for preventing a more serious conflagration. I am, sir, your obliged humble servant,

R. TEED.

Lancaster Court, Strand,
11 September, 1810.

---

*Rapid Disorganization of the Human Body.**

ON the night of the 16th of March, 1802, in one of the towns of the state of Massachusetts, the body of an elderly woman evaporated and disappeared from some internal and unknown cause, in the duration of about one hour and an half. Part of the family had gone to bed, and the rest were abroad. The old woman remained awake to take care of the house. By and by one of the grand-children came home, and discovered the floor near the hearth to be on fire. An alarm was made, a light brought, and means taken to extinguish it. While these things were doing, some singular appearances were observed on the hearth and the contiguous floor. There was a sort of greasy soot and ashes, with remains of a human body, and an unusual smell in the room. All the clothes were consumed; and the grandmother was missing. It was at first supposed she had, in attempting to light her pipe of tobacco, fallen into the fire, and been burned to death. But on considering how small the fire was, and that so total a consumption could scarcely have happened if there had been ten times as much, there is more reason to conclude that this is another case of that spontaneous decomposition of the human body, of which there are several instances on record. It is to be regretted the particulars have not been more carefully noted.

* Tilloch, vol. 14. p. 96.

*A singular Ignition and Oxydation of Iron.**

Dr. Juch gives the following singular notice:—

"I had," says he, "a small leather flask filled with iron filings, which I frequently used with my electrophorus both charged and uncharged. I had occasion one day for a quantity of pure iron, and having no other at hand, had recourse to the filings in the flask, which I knew were pure. I emptied it on a piece of paper. I laid the paper on my hand in order to convey it to the place of its destination; but I had scarcely held it a few seconds when I perceived a strong heat, which increased so much that I could no longer hold the paper. Some minutes after, the paper became brown, and at length took fire. It did not, however, flame. The iron filings were in a state of ignition; and when the heat had decreased, I found the iron converted into a highly friable oxyd."

No. 43.

Agenda; or a Collection of Observations and Researches the Results of which may serve as a Foundation for a Theory of the Earth. By M. De Saussure.

(Continued from page 267.)

CHAP. XVIII.

A. *Observations to be made on Volcanoes at the Time of an Eruption.*

1. The form, dimensions, and elevation of the crater.

2. The colour, elevation, and other sensible qualities of the flames and the smoke.

3. Phenomena which preceded the eruption, subterranean noise, earthquakes, extraordinary movements of the sea.

4. Phenomena which accompany the eruption; as

* Tilloch, vol. 5. p. 208.

thunder, lightning, positive or negative electricity, subterranean noise, earthquakes: scoriæ, ashes, and stones thrown up; to what height and distance.

5. Smell of the smoke. In general it indicates the sulphureous acid; but it may indicate also bitumen and coal.

6. Nature of the gases which escape during the eruption.

7. Velocity of the lava. Its degree of fluidity compared with the inclination of the ground over which it flows.

8. To measure, if possible, the degree of its heat when it issues from the volcano.

9. Whether the lava appears to be in a state of combustion, or only incandescence.

10. Whether it does not cool more slowly, and according to other laws, than that of the bodies heated or melted in our furnaces.

10. A. Can it be supposed that the matter thrown up by volcanoes was not inflamed, or even in a state of incandescence, in the bowels of the earth; and that it is only the contact of the air which gives it these qualities?

11. Whether the sudden cooling of lava in the air or in water divides it into prismatic columns, such as those of basaltes.

12. Whether it be true that scoria newly thrown up, and suddenly cooled by its rapid passage through the air, seems covered with a bituminous varnish.

13. And, in general, whether the mountain throws up bituminous matter or any thing that resembles the residuum of the combustion of coal, or whether it rather throws up pyrites or the residuum of their decomposition.

14. To ascertain by observations, and even by experiments, whether it may not be possible that pyrites or other ferruginous matters decomposed by water, undergo

a fermentation, which, acting on grand masses, may disengage a sufficient heat to produce the effects of a volcano.

15. Or whether, as M. Romme thinks, the fire of volcanoes is kept up by matters accumulated by rivers and currents of the sea.

16. To search for means of ascertaining the depth of the focus of the volcano.

17. To examine whether, at the moment when an eruption begins to take place, there is any remarkable change in the tides, currents, springs, and the nearest spiracles and volcanoes.

18. Muddy eruptions: their height, bulk, nature of the water they contain; whether it be saline: nature of the earth and stones thrown up; whether it contains sea shells, of what kinds, and in what state. Watery eruptions: the same researches: whether they hold in solution earths not usually soluble in water.*

B. *Observations to be made at all Times on Volcanoes decidedly such.*

19. Nature of the countries and mountains between which they are found.

20. History of the volcano: its form, height, and extent in the most ancient times; its successive changes down to the present moment; its lateral mouths, and the epochs of their formation.

21. Chronology and enumeration of its different eruptions; description of them, and their most remarkable characters.

22. To descend, if possible, into the craters of extinguished volcanoes; to measure their depth; describe

* To observe those excavations from which considerable currents of air issue either periodically or constantly. Tr.

their form, the nature of their sides, their strata, and the concretions adhering to them, such as sulphur, salt, &c.

22. A. To observe the *fumaroles*, or jets of smoke, often acid, which arise; their temperature, their nature, and their effects on the lava with which they come in contact.

23. To examine the fissures; whether they contain metallic or stony crystallisations, which may be considered as sublimed, and formed by the crystallisation of substances reduced to the state of smoke or vapour.

24. The nature of the streams of cooled lava; their extent and thickness.

25. Whether it be true that, in general, they are porous both at the upper and lower surfaces of the strata, and compact in the interior part.

26. To study the nature of the different currents placed above each other, in order to ascertain the difference that may have taken place in the focus of the volcano, and even in the source of its lava.

27. To examine, in general, in the lava, the nature of the earth and stones of which it has been formed.

27. A. To study the origin of the crystals found enclosed in the lava, as the white garnets or leucites in that of Vesuvius, in order to ascertain whether these crystals have been formed in the lava since the time of its fusion, or whether they pre-existed in the stones from which the lava was produced.

28. The nature and progress of the decomposition of the different kinds of lava, either by volcanic acids or meteors.

28. A. Whether there are any which have actually been in fusion, and yet have preserved all the external characters which the stone had before it was subjected to the action of the subterranean fires.

29. The origin of volcanic ashes, pozzolanas, tarras, tufas, &c.

30. The origin of pumice-stones: whether they are granites or feld-spars, asbestos, phrenites, deodalites, or potter's clay more or less ferruginous, or, lastly, the remains of the decomposition of pit-coal.

30. A. Whether, as M. de Fichtel believes, the action of the fire of volcanoes may augment the fusibility of feld-spar, and change it, in the same manner as quartz, into real zeolite.

31. Nature of the obsidians or volcanic glass: whether they be really glass, and the results of a complete fusion; or whether they are not rather stones of a vitreous appearance, and which have not been exposed to the action of a heat sufficiently strong to fuse them.

32. Whether there exist ancient kinds of lava, which, as related of those of Ischia, are susceptible of being heated by the moisture of rain and fogs, which would support the conjecture of No. 14.

C. *Observations to be made on Hills and Mountains which are doubted to have been really Volcanoes.*

33. The form, elevation, and other dimensions of the hill or mountain, the volcanic origin of which may appear doubtful.

34. Situation of its strata. To ascend to the summit of those which are inclined; to examine whether they have not a crater, or vestiges of one.

35. To observe, above all, whether, in departing from the most elevated point, there are found strata diverging in all parts, and proceeding from that point as a centre.

36. To study the characters of the stones which have been exposed to the action of the fire, in order to distinguish them from other porous stones, such as glandulous stones or amygdaloides.

37. When these characters are discovered, to examine whether, in the neighbourhood of the doubtful mountain, there are found scattered stones which exhibit the same characters, and which seem to have proceeded from that mountain.

38. To observe whether there are found, in the neighbourhood of the doubtful mountain, any vestige of the remains of heat concealed in the bosom of the earth, as of thermal, or even acidulous waters. It is well known that these signs are equivocal, but their combination with others may throw some weight into the scale.

38. A. Whether there exist certain proofs of alternate deposits of lava or other volcanic productions, and of matters accumulated or deposited by the sea.

39. Among the stones changed by the fire, to discover those which may be considered as having been subjected to the action of one stratum of coal in deflagration, and which the celebrated Werner calls *pseudo-volcanic*, and to distinguish them from those which have been fused in a real volcano.

40. Basaltes: their forms in columns, in beds, round masses; their connections, the relation which the basaltes of these different forms observe with each other.

41. The nature of these basaltes: that of their texture, of the points which they contain, of the pores and empty or full cells that may be observed in them; of their different accidents and decomposition.

41. A. The phenomena they exhibit in the fire, either exposed to, or sheltered from the action of the air. But before any arguments are drawn from these experiments, it will be necessary to resolve the question, Whether it be true that a stone may have been melted by subterranean fire, and yet none of its characters exhibit those indications of fusion which the fire of our furnaces would have given to the same stone.

42. Their connection, if there be any, with lava, fully ascertained as such: if it be true, for example, as M. Faujas affirms, that currents of lava are seen terminated by columns of basaltes.

43. The nature of the bases on which the basaltes rests: whether, as M. Werner says, any is found resting on wacke or hornstone, of an earthy and compact fracture, which itself reposes on sand or freestone.

44. Whether at other times basaltes is seen to repose on beds of coal (*houille*) which present no indications of combustion.

45. In a word, to examine whether the soil which bears them, or the sides of the veins in which they are contained, present indications of the action of fire, or at least of having been exposed to the contact of an incandescent mass; or, on the contrary, whether there appear indications of deposits of a substance which had been in a state of aqueous fluidity.

46. Whether there are in the basaltes vestiges of organised marine bodies or others; and in what state these vestiges are found.

47. Whether there are observed, as M. Faujas says, basaltes which seems to have formed a passage for itself from top to bottom through masses of granite.

48. In doubtful cases of this kind it would be necessary, were it possible to be at the expense, to push a gallery under a rock of basaltes, to examine whether the columns descend below the soil which seems to carry them; and if they are found below the soil, to sink a vertical well to ascertain the truth of the systems which suppose them to have been raised from the interior parts of the earth through the upper strata.

CHAP. XIX.

Researches to be made in regard to Earthquakes.

1. The historical part: the greatness, extent, and chronology of their ravages in different countries.

2. Does it appear that some countries are more exposed to them than others; are there some absolutely exempted; and how far is this connected with the local situation of the country?

3. To observe the extent, duration, and direction of the vibrations experienced by the earth when it shakes.

4. Are there any meteorological phenomena that announce or accompany earthquakes; such as extraordinary heat, calms, storms, movements of the barometer, electricity, vapours dispersed throughout the atmosphere, paleness or peculiar colour of the sun and stars?

5. Other phenomena; such as subterranean noise, extraordinary movement of the sea, the water of springs increased or dried up, any particular smell, symptoms of terror among domestic animals.

6. Are there any indications that some earthqakes may have been the effects of electricity, and that such convulsions might be prevented by conductors?

7. Are there not some also which immediately depend on subterranean fires, and which are preceded by or accompanied with volcanic eruptions?

8. Are there any which exhibit indications of the effects of water converted into steam?

9. To ascertain the simultaneous or at least astonishing rapidity of the effects of earthquakes at very great distances.

10. Are there any instances that, during the moment of an earthquake, some pretty considerable tract of land, or a mountain, has been raised to a great height above its

former level, and has afterwards remained in a state of elevation?

11. Are there dry fogs, such as that of 1783, which may be considered as vapours, that have issued from the earth by the action of shocks or concussions?

CHAP. XX.

Observations to be made on Mines of Metal, Coal, and Salt.

1. The historical part: the epoch of the discovery of a mine; of its being first worked; the expense and net produce at different periods. If there ever was, or still is, a grant of it, and on what conditions.

1. A. In regard to the physical part, care must be taken to examine whether the ore be in veins or strata; that is to say, whether it intersects the strata of the mountain, or be parallel to them.

2. In mines which consist of veins, the dimensions, thickness, and length of the veins are to be examined; their inclination in regard to the horizon, and their direction in regard to the cardinal points. The miners call this direction the *hours*.

3. The metal it contains; the mineralising substance, and the kind of mineral which thence results.

4. The matrix, or non-metallic fossil, found mixed with the ore.

5. The nature of the soil at the bottom, or that part of the mountain on which the vein rests; nature of the covering, or part of the mountain immediately above it.

6. Nature of the covering of the veins, or those parts of the vein next to the substance of the mountain.

7. Nature of the *druses*, or crystallised *geodes* contained in the vein.

7. A. The form, dimensions, and nature of the mountain which contains the vein.

8. Situation of the vein in regard to the strata of the mountain; under what angle it intersects them.

9. Its situation in regard to the exterior part of the mountain; whether it be parallel to the external inclination of the mountain, or whether that inclination be in a contrary direction.

10. The progress of the vein: whether it be subject to change its direction or situation, and according to what laws; if there are any indications that precede these changes; any corners, vacuities, or fissures, which interrupt the course of the vein; and how it is found after having been lost: situation and distance of the place where it is richest.

11. Lateral veins or ramifications of the principal vein; veins by which it is accompanied, or which run parallel to it.

12. To verify Werner's theory in regard to veins, the fundamental principles of which are as follows:—

A. That the spaces occupied by veins have been originally empty crevices or fissures.

B. That these fissures have been afterwards filled from the bottom upwards, at a time when the sea still covered the mountains; and by the precipitation or crystallisation of the substances which were before dissolved in the waters of the sea.

C. That of two veins crossing each other, the most modern is that which intersects the other.

D. That of two veins, one of which stops and diverts the course of the other, the most modern is the latter.

E. That, in the same vein, the parts nearest to the sides of the surrounding substance, the *salbande*, for instance, are the most ancient; those in the middle the most modern; and the intermediate ones of a mean antiquity.

F. Also that, in the same vein, the lowest parts are the most ancient.

G. That in some veins there are found rolled pebbles; in others the remains of organised bodies, shells, and wood; and in others, of coal, stones, and sea-salt.

H. That one may assign the relative age of the formation of different minerals; for example, that tin mines may be said to be of the most ancient formation; then those of uranite, bismuth, &c.

The greater part of the following questions will furnish confirmations of this theory, or objections against it, according to the solution given of them:

13. Is it true that there are mountains, or portions of mountains, so pierced with cotemporary veins that they could not have supported themselves, had not the substance with which they are filled been created at the same time as the mountain itself? I have used the expression cotemporary, because, if we can suppose that the fissures filled by these veins were formed in succession, the objection which this fact would present to the theory of Werner would be by these means resolved.

13. A. I must here repeat the 10th question of Chap. II. How can it be conceived that all the metals and substances found in a vein should have been dissolved by the water of the sea?*

14. Is it true that there are in Derbyshire vertical veins of lead intersected several times by horizontal strata of amygdaloides or loadstone?

15. Are there found, in the neighbourhood of veins, strata of the same mineral contained in these veins, and which seem to have been deposited at the same time when the deposits of the sea filled the fissures occupied by these veins?

* Or in the waters of the great ocean, which are supposed to have covered the whole globe of the earth. Tr.

16. Is it well ascertained that there are certain metals and certain kinds of ore found only in certain kinds of mountains? And, if this circumstance be true, does it arise from the relative age of these minerals and mountains, or from the substance of the mountains favouring the precipitation of one kind of mineral more than that of another?

17. Is it true, as M. de Trebra says, that the richest veins, and the richest points of any vein, are found in the vertical line which corresponds with the lowest part of the reservoirs of the rain water, and never in the peaks and most elevated ridges? And, if this be well ascertained, would it not prove that the veins had an origin posterior to the grand revolutions which have given to the surface of our globe its present form, and that the metals have been deposited in them by the meteoric waters?

18. Is it true also that the richest mines are found in mountains, the declivities of which are not steep?*

19. Are there instances of veins, entirely exhausted, being again filled up with ore?

20. Does the production of metals depend on the influence of the sun and climate? Are they more frequently found near the eastern or southern, than the western or northern faces of mountains?

21. Can we generalise the observation made in Siberia, Transylvania, at Mount Rose, and in other places, that in gold mines the veins are richer near the surface of mountains than at a greater depth?

21. A. Is it generally true that the veins are richer at their points of intersection than in any other place?

22. Is the inclination of veins seen more frequently

* As the Saxon authors generally say; because the fact is true among them and in some other countries, while the case is not so elsewhere, and particularly in the Pyrenees. Tr.

contrary, than parallel to, the adjacent face of the mountain?

23. Does it sometimes happen that the rock which forms the sides (*neben-gestein*) of the vein is as rich and even richer in metal than the vein itself; and would it thence follow, that the metal arrives at the vein by filtering itself through these sides?

24. Is it true that, in mountains of granite, the grain of the granite is finer and the stone more tender in the neighbourhood of a vein?

25. Are there observed in any mine proofs that subterranean fires have contributed to its formation by subliming the metallic substances, or by melting them? In a word, are there seen there any traces of the action of fire?

26. In the greater part of mines do we not, on the contrary, observe proofs of the action of water in the situation of minerals and of their matrices; in their *druses* (groups of crystals), and in the state, form, and nature of their crystallisation?

27. Does there prevail, at the bottom of mines, a heat superior to the mean temperature of the earth? And if such a heat exists in any mine, may it not be explained by that produced by the lamps; by the miners themselves; by some accumulations of pyrites, or some local reservoirs of water, without having recourse to a general cause or central fire?

28. Is it certain that, in general, veins decrease in thickness in proportion as they proceed to a greater depth, and terminate in such a manner that the fissures which contain them are closed at the bottom? Were this fact established, would it destroy the possibility of sublimations arising from the interior parts of the earth?*

* 28. A. Do there exist veins of from ten to twenty fathoms and more in thickness? or have not metalliferous banks or fissures between two different kinds of stone been taken for veins? Til.

29. In mines which proceed by strata, to observe their nature, extent, thickness, inclination, and depth; their interruption by the veins that intersect them; their alternate swellings and constrictions, as well as the augmentation and diminution of their richness, and the signs which precede these changes.

30. Whether it be rare to find, under the form of strata, other metallic mines than those of copper, iron, lead, calamine, and manganese.

31. Whether the mines in strata are generally poor near the surface of the mountain, and become richer the deeper they proceed.

31. A. Whether mines, where the metal is found in lumps or in a mass (*stockwerke*) ought to be classed among those in veins or those in strata?*

32. In coal mines to observe the nature of the coal; more or less compact; more or less rich in bitumen; more or less mixed with argil or pyrites.

33. To examine, in the coal, the traces of their origin; whether they have been formed of wood, turf, or marine plants.†

34. To observe whether there are found the remains of marine or terrestrial animals.

35. The progress of the strata: whether it be true that they often begin by descending in order to become horizontal, and afterwards to re-ascend; and that they

* 31. B. To observe also a third position of the ore, or ore found in the transitions (*stein-scheidung*); that is to say, between two kinds of stone of a very different nature; as between argillaceous schist and calcareous stone, between the same schist and compound rocks, &c. Not to confound this position of ore with real veins, nor with metalliferous banks, ore in strata, and the *stockwerke*. Til.

† 33. A. To distinguish carefully real coal from jet or fossil coal (the *braun-kohle* of the Germans), and from coal earth, as well as from that substance known by the Germans under the name of *blend-kohle*. Til.

33. B. To examine whether there is not found sometimes in calcareous soil, fat, gelatinous coal; or whether there is never found but dry, friable coal. Til.

are thickest in the horizontal part, and give coal of a better quality.*

36. Whether there are several strata, one above the other, with banks or other fossils interposed. The quality and relation of these strata.

37. The nature and thickness of the strata of the earth or stones under which the coal mine is found; the impressions and other vestiges of organised bodies found in these strata.

37. A. How can those who ascribe the origin of coal to forests buried in the earth, explain the very thin strata of that fossil contained between banks of calcareous stones, and which are repeated at different heights in the same mountain? Does not this observation shew that there are coal which have originated also from fuci, algæ, and other marine plants?

37. B. Ought we to suppose that all coals have been in a state of solution? What is the agent which dissolved them, and which may be called the mineraliser?

38. Though mines of rock salt are commonly found in strata, yet M. Fichtel affirms, that there are found in Transylvania enormous masses of pure salt, compact, and without any appearance of foreign bodies. These he considers as of very ancient formation, and distinguishes them from those which are in strata between beds of argil and free-stone mixed with shells. These important facts deserve to be thoroughly examined.

39. To ascertain the truth of an assertion made by the same geologist, that these masses of salt are surrounded by ancient volcanoes; and to determine whether we ought to believe with him, that this salt has been crystallised by the heat of those volcanoes which evaporated the water that held them in solution.

* 35. A. To ascertain whether there exists fossil coal in veins, as is said to be the case at Wehrau in Upper Lusatia. Til.

40. To examine, in the last place, whether any of these masses of salt appear to have been raised up by subterranean fires to a height greater than that at which they were at the time of their formation.

41. To examine the reason of the singular connection observed between mines of salt or salt springs and mountains of gypsum.*

(To be continued.)

No. 44.

A Treatise on the Cultivation of the Vine, and the Method of making Wines. *By* C. CHAPTAL.

(Continued from page 277.)

IV. *Of Fermentation.*

THE must is scarcely put into the vat when it begins to ferment. That which flows from the grapes by the pressure or agitation they receive during the carriage, works and ferments before it arrives at the vat. This is a phænomenon which any one may easily observe by following the vintagers in warm climates, and carefully examining the must which issues from the grapes and remains mixed with them in the vessel used for carrying them.

The ancients carefully separated the first juice, which can arise only from the ripest grapes, and which flows naturally by the effect of the slightest pressure exercised on them. They caused it to ferment separately, and obtained from it a delicious beverage, which they called

* And particularly of gypsum coloured by a red argil. To examine also why asphaltes is commonly found in the neighbourhood of salt-pits.

42. To observe the different efflorescence of the different salts formed on the rocks and the surface of the earth, in order to determine their nature.

43. To observe also the nature, the abundance, and what may be discovered in regard to the origin of mineral waters: to determine the temperature of them. Tit.

protopon. Mustum sponte defluens, antequam calcentur uvæ. Baccius has described a similar process practised by the Italians: *Qui primus liquor non calcatis uvis defluit, vinum efficit virgineum, non inquinatum fæcibus; lacrymam vocant Itali; cito potui idoneum fit et valde utile.* But this virgin liquor forms only one part of the juice which the grapes can furnish, and it cannot be treated separately, except when it is required to obtain wine very delicate and little coloured. In general, this first liquor is mixed with the rest of the grapes which have been trod, and the whole is left to ferment.

The vinous fermentation is always effected in vats of stone or of wood. Their capacity in general is proportioned to the quantity of the grapes collected from one vineyard. Those constructed of mason-work are for the most part of good cut stone, and the inside is often lined with bricks, joined together by a cement of pozzolano or strong clay. Wooden vats require more care to maintain them, are more subject to variations of temperature, and liable to more accidents.

Before the vintage is put into the vat, care must be taken to clean it. It must therefore be washed with warm water and well scrubbed, and the sides must be covered with two or three strata of lime. This covering is attended with this advantage, that it saturates a part of the malic acid, which exists abundantly in the must, as we shall show hereafter.

As the whole process of vinification takes place during the fermentation, since it is by it alone that the *must* passes to the state of *wine*, we think it necessary to consider this important subject under several points of view. We shall first speak of the causes which contribute to produce fermentation; we shall then examine its effects or its product, and shall conclude with deducing, from what we actually know on the subject, some general

principles which may direct the agriculturist in the art of managing it.

Of the Causes which have an Influence on Fermentation.

It is well known that to establish fermentation, and make it follow all its periods in a regular manner, some conditions with which observation has made us acquainted are necessary. A certain degree of heat, the contact of the air, the existence of a sweet and saccharine principle in the must—such are nearly the conditions that are requisite; we shall endeavour to make known the effects produced by each of them.

1. *Influence of the Temperature of the Atmosphere on Fermentation.*

The 54th degree of Fahrenheit is pretty generally considered as the temperature most favourable to spiritous fermentation; below that degree it is languid; above, it becomes too tumultuous. At a temperature too cold or too hot, it does not take place at all. Plutarch observed that cold could prevent fermentation, and that the fermentation of must was always proportioned to the temperature of the atmosphere.* Bacon recommends the immersion of vessels containing wine, in the sea, to prevent its decomposition. Boyle relates, in his Treatise on Cold, that a Frenchman, to keep his wine in the state of must, and preserve to it that sweetness of which some persons are fond, closed the cask hermetically, and immersed it in a well or a river. In all these cases the liquor was not only kept in a temperature very unfavourable to fermentation, but it was secured from the contact of the air, which checks, or at least moderates, fermentation.

An extraordinary phenomenon, but which seems con-

* Quæst. Nat. 27.

firmed by a sufficient number of observations to merit full belief, is, *that fermentation is slower as the temperature has been colder at the time of collecting the grapes.* Rozier found in 1769, that grapes collected on the 7th, 8th, and 9th of October remained in the vat till the 19th without showing the least sign of fermentation: the thermometer in the morning had been at 3¼ degrees below freezing, and maintained itself at + 4. The fermentation was not completed till the 25th; while similar grapes collected on the 16th, at a temperature much less cold, terminated their fermentation on the 21st or 22d. The same thing was observed in 1740.

In consequence of these principles, it has been recommended to place the vats in covered places; to remove them from damp and cold places; to cover them, in order to moderate the cold of the atmosphere; to heat again the mass by introducing boiling must; and to make choice of a warm day for collecting the grapes, or to expose them to the sun, &c.

2. *Influence of the Air on Fermentation.*

We have seen in the preceding article that fermentation may be moderated and retarded by withdrawing the must from the direct action of the air, and keeping it exposed to a cool temperature. Some chemists, in consequence of these facts, are of opinion that fermentation can take place only by the action of the atmospheric air; but a more attentive observation of all the phenomena it presents in its different states, will enable us to set a just value on all the opinions which have been entertained on that subject.

The air, no doubt, is favourable to fermentation. This truth seems established by a concurrence of all the facts known; for, when preserved from the contact of the air, must will keep a long time without any change or altera-

tion. But it is proved also, that though must shut up in close vessels undergoes very slowly the phenomena of fermentation, it at length terminates, and that the wine produced by it is more generous. This is the result of the experiments of D. Gentil.

If a little yeast of beer and molasses, diluted in water, be introduced into a flask with a bent beak, and if the beak of the flask be opened under a bell filled with water, and inverted over a pneumatic tub, at the temperature of 60 or 65 degrees; according to my observations, the first phenomena of fermentation will always appear a few minutes after the apparatus has been thus arranged; the vacuum of the flask soon becomes filled with bubbles and foam; a great deal of carbonic acid passes under the bell; and this movement does not cease till the liquor has become spirituous. In no case have I ever seen an absorption of atmospheric air.

If, instead of giving free vent to the gaseous matters which escape by the process of fermentation, their disengagement be checked by keeping the fermenting mass in close vessels, the movement then slackens, and the fermentation terminates only with difficulty and after a very long time.

In all the experiments which I tried on fermentation, I have never seen that the air was absorbed. It neither enters into the product as a principle, nor into the decomposition as an element; it is expelled from the vessels with the carbonic acid, which is the first result of the fermentation.

Atmospheric air, then, is not necessary to fermentation; and if it appears useful to establish a free communication between the must and the atmosphere, it is because the gaseous substances which are formed in the fermentation may then escape, by mixing with or dissolving in the surrounding air. It follows also from this

principle, that when the must is put into close vessels the carbonic acid will find obstacles to its volatilisation: it will be forced to remain interposed in the liquid; it will be dissolved there in part, and, making a continual effort against the liquid, and each of the parts of which it is composed, it will slacken and extinguish almost completely, the act of fermentation.

That fermentation therefore may be established, and pass through all its periods in a speedy and regular manner, there must be a free communication between the fermenting mass and the atmospheric air. The principles which are then disengaged by the process of fermentation easily enter the atmosphere, which serves them as a vehicle, and the fermenting mass from that moment may, without any obstacle, experience movements of dilatation and expansion.

If wine fermented in close vessels is more generous and more agreeable to the taste, the reason is, that it has retained the aroma and the alcohol, which are in part lost in fermentation that takes place in the open air; for, besides their being dissipated by the heat, the carbonic acid carries them to a state of absolute solution, as we shall show hereafter.

The free contact of the atmospheric air accelerates fermentation, and occasions a great loss of principles in the alcohol and aroma; while, on the other hand, the withdrawing of that contact slackens the movement, threatens explosion and rupture, and the fermentation requires a long time to be complete. There are therefore advantages and disadvantages on both sides; but perhaps it might be possible to combine these two methods with so much success as to remove all their disadvantages. This, no doubt, would be the highest point of vinification. We shall see hereafter that some processes practised in different countries, either for making brisk wines, or

preserving to them a certain agreeable perfume, give us reason to hope for a more happy result of the labours that may be undertaken on this subject by persons of ability.

3. *Influence of the Volume of the fermenting Mass on Fermentation.*

Though the juice of the grape ferments in a very small mass, since I have made it pass through all its periods of decomposition in glasses placed on a table; it is nevertheless true, that the phenomena of fermentation are powerfully modified by difference of volumes.

In general, fermentation is the more rapid, speedier, more tumultuous, and more complete, as the mass is more considerable. I have seen the fermentation of must in a cask not terminated till the eleventh day; while a vat filled with the same liquor, and containing twelve times the volume of the cask, ended on the fourth day. The heat in the cask never exceeded 70 degrees; in the vat it rose to 88.

It is an incontestable principle, that the activity of fermentation is proportioned to the mass; but we must not thence conclude that it is always of advantage to carry on the process of fermentation in a large mass, or that the wine arising from fermentation established in the largest vats has superior qualities: there is a term for every thing, and there are extremes equally dangerous, which must be avoided. To have complete fermentation, care must be taken not to obtain it with too great precipitation. It is impossible to determine the volume most favourable to fermentation; it even appears that it ought to be varied according to the nature of the wine and the object proposed. If it be the preservation of the aroma, it ought to be performed with a smaller mass than when it is required to develope all the spirituous part to make wines proper for distillation. I have seen the thermome-

ter rise to 92 degrees in a vat containing thirty *muids* * of vintage Languedoc measure. In that case, indeed, all the saccharine principle is decomposed; but there is a loss of a portion of the alcohol by the heat and the rapid movement which the fermentation produces.

In general, the capacity of the vats ought to be varied according to the nature of the grapes. When they are very ripe, sweet, saccharine, and almost dry, the must has a thick consistence, &c. fermentation takes place with difficulty, and a great mass of liquid is required that the syrupy juice may be entirely decomposed; otherwise the wine remains thick, sweetish, and too luscious. It is only after being long kept in the cask that this liquor acquires that degree of perfection to which it is capable of attaining.

The temperature of the air, the state of the atmosphere, and the weather which prevails during the vintage—all these causes and their effects must be always present in the mind of the agriculturist, that he may be able to deduce from them rules proper for directing his conduct in regard to this object.

4. *Influence of the constituent Principles of Must on Fermentation.*

The sweet and saccharine principle, water, and tartar, are the three elements of the grape which seem to have a powerful influence on fermentation: it is not only to their existence that the first cause of this sublime operation is due, but it is to the very variable proportions of these different constituent principles that we must refer the principal differences exhibited by fermentation.

1st, It appears proved, by comparing the nature of all the substances which undergo spiritous fermentation,

* A *muid* contains 300 quarts, comprehending stalks, skins, and dregs. Tr.

that none are susceptible of it but those which contain a sweet and saccharine principle; and it is beyond a doubt that it is at the expense of this principle that alcohol is formed. By a consequence which naturally flows from this fundamental truth, bodies in which the saccharine principle is most abundant ought to furnish the most spiritous liquor. This is what is confirmed by experience. But it is impossible to insist too much on the necessity of making a careful distinction between *sugar* properly so called and the *sweet principle*. Sugar without doubt exists in grapes, and it is to it in particular that is owing the alcohol which results from its decomposition by fermentation; but this sugar is constantly mixed with a sweet body, more or less abundant, and very proper for fermentation: it is a real leaven, which almost every where accompanies sugar, but which by itself cannot produce alcohol. Hence it happens that, when it is necessary to ferment sugar in order to obtain rum, it is employed in the state of syrup called *vezou*, because it then contains the sweet principle which facilitates the fermentation.

The distinction between the sweet principle and sugar properly so called has been very well established by Deyeux in the *Journal des Pharmaciens*.

This sweet principle is almost inseparable from the principle of sugar in the products of vegetation; and these two principles are so well combined in some cases that they cannot be completely *disunited* but with difficulty. This is what will long prevent sugar, perhaps, from being extracted for commerce from several vegetables which contain it. The sugar-cane appears to be that of all the vegetables in which this separation is easiest. Many facts induce us to believe that this sweet principle approaches near in its nature to the saccharine principle; that, under favourable circumstances, it may

even be converted into sugar: but the present is not the moment for discussing this important point.

Grapes, then, may be very sweet and very agreeable to the taste, yet produce very bad wine: because sugar may exist only in very small quantity in grapes which to appearance are highly saccharine. This is the reason why grapes exceedingly sweet to the taste do not always furnish the most spiritous wines. In a word, a very little practice is sufficient to enable us to distinguish the really saccharine savour from the sweet taste which some grapes possess. Thus the mouth habituated to taste the highly saccharine grapes of the south, will not confound with them the *chasselas*, though very sweet, of Fontainebleau.

We ought therefore to consider sugar as the principle which gives rise to the formation of alcohol by its decomposition, and sweet and saccharine bodies as the real leaven of spiritous fermentation. That must, then, may be proper for undergoing a good fermentation, it ought to contain these two principles in proper proportions: sugar alone does not ferment, or at least the fermentation of it is slow and incomplete. Pure mucilage does not furnish alcohol; it is only to the union of these two substances that we are indebted for good spiritous fermentation.*

2d, Very aqueous must, as well as too thick must, experiences fermentation with difficulty. A proper degree of fluidity, then, is necessary to obtain good fermentation; and this is presented by the expressed juice of grapes which have come to perfect maturity.

When the must is very aqueous the fermentation is slow and difficult, and the wine arising from it is weak, and very susceptible of decomposition. In this case the

* There are some mucous bodies capable of undergoing spiritous fermentation; but it is probable that these mucous bodies contain sugar, which is more difficult to be extracted in proportion as the quantity is less.

ancients were accustomed to boil their must: by these means they caused the supernatant water to evaporate, and brought back the liquor to the proper degree of thickness. This process, always advantageous in the northern countries, and in general wherever the season has been rainy, is still practised. Maupin has even contributed to make this method be more adopted, in proving, by numerous experiments, that it may be used with advantage in almost all the wine countries. It however appears to be useless in warm climates; it is not applicable but in cases when the season having been rainy, has not permitted the grapes to attain to the proper degree of maturity, or when the vintage has taken place during wet or foggy weather.

There are some countries where baked plaster is mixed with the grapes to absorb the excess of humidity they may contain. The custom established in other places of drying the grapes before they are fermented is founded on the same principle. All these processes tend in an essential manner to remove the humidity with which the grapes may be impregnated, and to present a thicker juice to fermentation.

3d, The juice of ripe grapes contains tartar, which may be shown in it merely by concentrating the liquor, as we have observed: but verjuice furnishes a still greater quantity; and it is generally true that grapes give less tartar the more sugar they contain.

The marquis de Bouillon extracted from $2\frac{1}{2}$ wine pints of must about 10 dwts. of sugar and $1\frac{1}{2}$ dwt. of tartar. It appears from the experiments of the same chemist, that tartar as well as sugar concurs to facilitate the formation of alcohol. To obtain three times as much ardent spirit, nothing is necessary but to increase the proportion of the tartar and the sugar.

The same chemist has also proved that must deprived

of its tartar does not ferment, but that the property of fermenting may be restored to it by restoring to it that principle.

About 120 quarts of water, 100 ounces of sugar, and a pound and a half of cream of tartar, remained three months without fermenting. About 16 pounds of pounded vine-leaves were added, and the mixture fermented strongly for fifteen days. The same quantity of water and vine-leaves, left to ferment without sugar and without tartar, produced only an acidulous liquor.

In 500 quarts of cassonade and 10 pounds of cream of tartar fermentation was fully established, and continued forty-eight hours longer than in vats which contained simple must. The wine resulting from the first fermentation furnished one part and a half of brandy, at twenty degrees of Beaumé's areometer, in seven parts which had been distilled; while the wine made without the addition of sugar or tartar produced only a twelfth part of spirit at the same degree.

Saccharine grapes require, in particular, the addition of tartar: it is sufficient for this purpose to boil it in a kettle with the must, in order that it may be dissolved. But when must contains tartar in excess, it may be disposed to furnish ardent spirit by adding to it sugar.

It appears, then, from these experiments, that tartar facilitates fermentation, and concurs to render the decomposition of the sugar more complete.

Phenomena of the Products of Fermentation.

Before we enter into a detail of the principal phenomena exhibited by fermentation, we think it proper to trace out briefly the progress it follows in its periods.

Fermentation first announces itself by small bubbles which appear on the surface of the must; by degrees some are seen to arise from the centre even of the mass

in a state of fermentation, and to burst at the surface; their passage through the strata of the liquid agitates all its principles, displaces all their moleculæ, and there soon results a hissing noise similar to that produced by a gentle ebullition.

Small drops, which immediately fall back, are then seen to rise several inches above the surface of the liquid. In that state the liquor is turbid, and every thing is mixed, confounded, agitated, &c.; filaments, pellicles, flakes, grapes, and stones, float separately, and are pushed, expelled, precipitated, and thrown up, till they at length settle at the surface, or are deposited at the bottom of the vessel. In this manner, and by a series of intestine movement, there is formed at the surface of the liquor a crust of greater or less thickness, called by the French *le chapeau de la vendange.*

This rapid movement and continual disengagement of these aëriform bubbles considerably increase the volume of the mass. The liquor rises in the vat above its primitive level. The bubbles, which experience some resistance to their volatilisation by the thickness and tenacity of the *chapeau,* force a passage to themselves in certain points, and produce abundant froth.

The heat increasing in proportion to the energy of the fermentation, an odour of spirit of wine is disengaged, and diffused every where around the vat; the liquor assumes a darker colour; and after several days, and sometimes even after a few hours, tumultuous fermentation, the symptoms decrease; the mass resumes its former volume, the liquor becomes bright, and the fermentation is almost terminated.

Among the most striking phenomena and the most sensible effects of fermentation, there are four principal ones which require particular attention; the production of

heat, the disengagement of gas, the formation of alcohol, and the coloration of the liquor.

I shall here speak of each of these phenomena, according to what we know of them with certainty from observation.

1st, *Production of Heat.*—It sometimes happens in cold countries, but particularly when the temperature is above 55 degrees, that the liquor put into the vat experiences no fermentation, unless some means can be found to heat the mass. This may be done by introducing into it warm must, stirring the liquor strongly, heating the atmosphere, or covering the vat with cloths.

But as soon as the fermentation begins, the heat acquires intensity. Sometimes a few hours' fermentation is sufficient to carry it to the highest degree. In general it is in the ratio of the swelling up of the mass; it increases and decreases like it, as will be proved by the experiments which I shall subjoin to this article.

The heat is not always equal throughout the whole mass; it is often more intense towards the middle, especially when the fermentation is not sufficiently tumultuous to mix and confound by violent movements all the parts of the mass: in that case the vintage is trod again; it is agitated from the circumference to the centre, and an equal temperature is established in every point.

We may admit as incontestable truths: 1st, That, at an equal temperature, the greater the mass of the vintage the greater will be the effervescence, movement, and heat. 2d, That the effervescence, the movement, and heat, are greater in vintage where the juice of the grapes is accompanied with the pellicles, stones, stalks, &c. than in must separated from all these matters. 3d, That fermentation can produce from 59 to 95 degrees of heat: at least, I have seen it in activity between these two extremes.

2d, *Disengagement of Gas.*—The carbonic acid gas disengaged from the vintage, and its effects hurtful to respiration, have been known since fermentation itself was known. This gas escapes in bubbles from every point of the vintage, rises in a mass, and bursts at the surface. It displaces the atmospheric air which rests on the vintage, occupies every where the vacant parts of the vat, and flows over the edges, precipitating itself in the lowest places on account of its gravity. It is to the formation of this gas, which takes a portion of oxygen and carbon from the constituent principles of the must, that we shall in future refer the changes which take place in fermentation.

This gas, retained in the liquor by all the means that can be opposed to its evaporation, contributes to preserve the aroma and a portion of alcohol which exhales along with it. The ancients were acquainted with these means, and they carefully distinguished the product of a *free* from that of a *close* fermentation; that is to say, the fermentation effected in open and that effected in close vessels. Brisk wines are indebted for that quality to their having been shut up in the bottles before their fermentation was completed. This gas, being slowly developed in the liquor, remains compressed in it till the moment when, the effort of the compression having ceased, by the opening of the vessels it can escape with force.

This acid gas gives to all liquors impregnated with it a tartish savour. Those mineral waters called *gaseous waters* are indebted to it for their principal virtue. But it would be having a very incorrect idea of its real state in wine, to compare its effects to those which it produces by its free solution in water.

The carbonic acid disengaged from wine holds in solution a pretty considerable portion of alcohol. I think I was the first who made known this fact, when I show-

ed, that by exposing pure water in vessels placed immediately above the *chapeau* of the vintage, at the end of two or three days this water is impregnated with carbonic acid, and that, to obtain very good vinegar, nothing is necessary but to put it into uncorked bottles, and to leave it to itself for a month. At the same time that the vinegar is formed, abundance of flakes, which are of a nature analagous to fibrous matter, are precipitated in the liquor. When water containing earthy sulphats, such as well-water, is employed instead of pure water, there is disengaged at the moment of acetification an odour of sulphurated hydrogen gas, which arises from the decomposition of the sulphuric acid itself. This experiment sufficiently proves that the carbonic acid gas carries with it alcohol and a little extractive matter; and that these two principles, necessary for the production of the acetous acid, being afterwards decomposed by the contact of the atmospheric air, produce acetous acid.

But is the alcohol dissolved in the gas, or is it volatilised merely by the heat? This question cannot be determined by direct experiments. Gentil observed in 1779, that when a glass bell was inverted over the vintage in fermentation, the inside of it became covered with drops of a liquid which had the smell and properties of the first phlegm that passes when spirits are distilled. Humboldt has proved that if the vapour of champagne be received under bells, in an apparatus for collecting gas, surrounded with ice, alcohol is precipitated on the sides merely by the impression of the cold. It appears, then, that the alcohol is dissolved in the carbonic acid gas, and it is this substance which communicates to the vinous gas a part of its properties. Every one feels, by the impression which the vapour of champagne makes on our organs, how this gaseous matter is modified, and differs from pure carbonic acid.

It is not the most saccharine must that furnishes the most gaseous acid, nor is it that employed in general for making the briskest wines. If the fermentation of this kind of grapes were checked by shutting them up in casks or jars to preserve the gas disengaged from them, the saccharine principle, which abounds in them, would not be decomposed, and the wine would be sweet, luscious, thick, and disagreeable. There are some wines all the alcohol of which is dissolved in the gaseous principle: that of Champagne furnishes a proof of it.

It is difficult to obtain wine red and brisk at the same time; especially as, to make it acquire colour, it must be suffered to ferment over the skins, stalks, &c.; and as by these means the acid gas is dissipated.

There are some wines the slow fermentation of which continues for several months. These, if put into bottles at the proper time, become brisk: there are none, strictly speaking, but wines of this kind capable of acquiring that property. Those the fermentation of which is naturally tumultuous terminate this process too soon, and would break the vessels in which they are enclosed.

This acid gas is dangerous to be respired. All animals exposed to it are suffocated. Such melancholy accidents are much to be apprehended when the vintage is made to ferment in low places where the air is not renewed. This gaseous fluid displaces the atmospheric air, and at last fills the whole cellar. It is the more dangerous as it is invisible like air; and too much precaution cannot be taken against its fatal effects. To ascertain whether there be any danger, those who enter a place where vintage is in a state of fermentation ought to cause a lighted candle to be carried before them: if the candle continues burning, there is no danger; but if it is seen to grow dim, and then to go out, it will be prudent to retire.

This danger may be prevented by saturating the gas

ed, that by exposing pure water in vessels placed immediately above the *chapeau* of the vintage, at the end of two or three days this water is impregnated with carbonic acid, and that, to obtain very good vinegar, nothing is necessary but to put it into uncorked bottles, and to leave it to itself for a month. At the same time that the vinegar is formed, abundance of flakes, which are of a nature analagous to fibrous matter, are precipitated in the liquor. When water containing earthy sulphats, such as well-water, is employed instead of pure water, there is disengaged at the moment of acetification an odour of sulphurated hydrogen gas, which arises from the decomposition of the sulphuric acid itself. This experiment sufficiently proves that the carbonic acid gas carries with it alcohol and a little extractive matter; and that these two principles, necessary for the production of the acetous acid, being afterwards decomposed by the contact of the atmospheric air, produce acetous acid.

But is the alcohol dissolved in the gas, or is it volatilised merely by the heat? This question cannot be determined by direct experiments. Gentil observed in 1779, that when a glass bell was inverted over the vintage in fermentation, the inside of it became covered with drops of a liquid which had the smell and properties of the first phlegm that passes when spirits are distilled. Humboldt has proved that if the vapour of champagne be received under bells, in an apparatus for collecting gas, surrounded with ice, alcohol is precipitated on the sides merely by the impression of the cold. It appears, then, that the alcohol is dissolved in the carbonic acid gas, and it is this substance which communicates to the vinous gas a part of its properties. Every one feels, by the impression which the vapour of champagne makes on our organs, how this gaseous matter is modified, and differs from pure carbonic acid.

It is not the most saccharine must that furnishes the most gaseous acid, nor is it that employed in general for making the briskest wines. If the fermentation of this kind of grapes were checked by shutting them up in casks or jars to preserve the gas disengaged from them, the saccharine principle, which abounds in them, would not be decomposed, and the wine would be sweet, luscious, thick, and disagreeable. There are some wines all the alcohol of which is dissolved in the gaseous principle: that of Champagne furnishes a proof of it.

It is difficult to obtain wine red and brisk at the same time; especially as, to make it acquire colour, it must be suffered to ferment over the skins, stalks, &c.; and as by these means the acid gas is dissipated.

There are some wines the slow fermentation of which continues for several months. These, if put into bottles at the proper time, become brisk: there are none, strictly speaking, but wines of this kind capable of acquiring that property. Those the fermentation of which is naturally tumultuous terminate this process too soon, and would break the vessels in which they are enclosed.

This acid gas is dangerous to be respired. All animals exposed to it are suffocated. Such melancholy accidents are much to be apprehended when the vintage is made to ferment in low places where the air is not renewed. This gaseous fluid displaces the atmospheric air, and at last fills the whole cellar. It is the more dangerous as it is invisible like air; and too much precaution cannot be taken against its fatal effects. To ascertain whether there be any danger, those who enter a place where vintage is in a state of fermentation ought to cause a lighted candle to be carried before them: if the candle continues burning, there is no danger; but if it is seen to grow dim, and then to go out, it will be prudent to retire.

This danger may be prevented by saturating the gas

in proportion as it is precipitated on the floor, by scattering in several places milk of lime, or quicklime. A place rendered noxious by this pernicious gas may be purified by throwing upon the floor and against the walls quicklime diluted in water: a caustic alkaline ley, such as soapmakers' ley or ammonia, will produce a similar effect. In all cases the gaseous acid instantly combines with these matters, and the external air descends to occupy its place.

3d, *Formation of Alcohol.*—The saccharine principle exists in must, and makes one of its principal characters: it disappears by fermentation, and is replaced by alcohol; which essentially characterises wine.

We shall mention hereafter in what manner this phenomenon, or this interesting series of decompositions and productions, may be conceived. Our business at present is to indicate the principal facts which accompany the formation of alcohol.

As the object and effect of spiritous fermentation are merely the production of alcohol by decomposing the saccharine principle, it thence follows that the formation of the one is always in proportion to the destruction of the other, and that the alcohol will be more abundant as the saccharine principle is greater: for this reason, the quantity of alcohol may be augmented at pleasure by adding to the must the sugar which seems to be wanting.

It invariably follows from these principles, that the nature of the vintage in fermentation is every moment modified and changed: its smell, taste, and other characters, are continually varying. But as there is a very constant progress in the process of fermentation, it may be followed in all its changes, which may be considered as invariable signs of the different states through which the vintage passes.

1st, Must has a sweetish odour, which is peculiar to

it. 2d, Its savour is more or less saccharine. 3d, It is thick, and its consistence varies according as the grapes are more or less ripe, more or less saccharine. I have found by experience that some marked 75 degrees of the areometer, and others only from 40 to 42. It is exceedingly soluble in water. Scarcely is the fermentation determined when all the characters are changed: the odour begins to become pungent by the disengagement of carbonic acid; the savour, still very sweet, is however already mixed with a little of the pungent; the consistence decreases; the liquor, which hitherto presented only one uniform whole, exhibits flakes which become more and more insoluble.

The saccharine savour becomes gradually weaker, and the vinous stronger: the consistence of the liquor is sensibly lessened: the flakes detached from the mass are more completely insulated. The odour of the alcohol is perceived at a greater distance.

At last the moment arrives when the saccharine principle is no longer sensible; the savour and smell now indicate nothing but alcohol: all the saccharine principle, however, is not destroyed; a portion of it still remains; the existence of which is not masked by that of the predominant alcohol, as is confirmed by the very correct experiments of Gentil. The further decomposition of this substance takes place by the aid of the tranquil fermentation which is continued in the casks.

When the fermentation has passed through, and terminated all its periods, no more sugar exists; the liquor has acquired fluidity, and presents only alcohol mixed with a little extract and colouring principle.

4th, *Coloration of the vinous Liquor.*—The must which flows from the grapes transported from the vineyard to the vat before they have been trod, ferments

alone, produces *virgin wine*, the *protopon* of the ancients, which is not coloured.

Red grapes, the juice of which is expressed by mere treading, always furnish white wine when not fermented with the skins, stalks, &c.

Wine becomes more and more coloured as the vintage remains longer without being fermented. Wine is less coloured as the grapes have been less trod, as greater care has been taken to cause them to ferment in the skins, &c.

Wine is more coloured as the grapes are riper and less aqueous.

The liquor furnished by the skins, &c. when subjected to the press is less coloured.

The southern wines, and, in general, those made from grapes collected in places well exposed to the south, are more coloured than the wines of the north.

Such are the practical axioms which have been sanctioned by long experience. Two fundamental truths thence result: the first is, that the colouring principle of wine exists in the skins of the grapes; the second is, that this principle does not detach itself, and is not completely dissolved in the vintage but when the alcohol is developed in it.

We shall treat in the proper place of this colouring principle, and shall show, that though it approaches resins in some of its properties, it is, however, essentially different.

Any one, after this short explanation, may account for all the processes usual for obtaining wines more or less coloured; and may readily conceive that it is in the power of the agriculturist to give to his wines whatever tint of colour he chooses.

(To be continued.)

No. 45.

Method of obviating the Necessity of lifting Ships. By Mr. Robert Seppings, *of Chatham Yard.**

The following is a description of an invention by Mr. Robert Seppings, late master shipwright assistant in his majesty's yard at Plymouth (now master shipwright at his majesty's yard, Chatham), for suspending, instead of lifting, ships, for the purpose of clearing them from their blocks, by which a very great saving will accrue to the public, and also two-thirds of the time formerly used in this operation.

From the saving of time another very important advantage is derived, namely, that of enabling large ships to be docked, suspended, and undocked, the same spring tides. Without enumerating the inconveniencies arising, and, perhaps, injuries, which ships are liable to sustain, from the former practice of lifting them, and which are removed by the present plan; that which relates to manual labour deserves particular attention; twenty men being sufficient to suspend a first-rate, whereas it would require upwards of 500 to lift her. The situation which Mr. Seppings held in Plymouth-yard, attached to him, in a great degree, the shoring and lifting of ships, as well as the other practical part of the profession of a shipwright. Here he had an opportunity of observing, and indeed it was a subject of general regret, how much time, expense, and labour, were required in lifting a ship, particularly ships of the line. This induced him to consider whether some contrivance could not be adopted to obviate these evils. And it occurred to him, that if he

* Tilloch, vol. 22. p. 242. From the Transactions of the Society of Arts, who voted him the gold medal, 1804.

could so construct the blocks on which the ship rests, that the weight of the ship might be applied to assist in the operation, he could accomplish this very desirable end. In September, 1800, the shoring and lifting the San Josef, a large Spanish first-rate, then in dock at Plymouth, was committed to his directions; to perform which, the assistance of the principal part of the artificers of the yard was requisite. In conducting this business, the plan, which will be hereafter described, occurred to his mind; and from that time, he, by various experiments, proved his theory to be correct: the blocks, constructed by him, upon which the ship rests, being so contrived, that the facility in removing them, is proportionate to the quantity of pressure; and this circumstance is always absolutely under command, by increasing or diminishing the angle of three wedges, which constitute one of the blocks; two of which are horizontal, and one vertical. By enlarging the angle of the horizontal wedges, the vertical wedge becomes of consequence more acute; and its power may be so increased, that it shall have a great tendency to displace the horizontal wedges, as was proved by a model, which accompanied the statement to the society; where the power of the screw is used as a substitute for the pressure of the ship.

Mr. Seppings caused three blocks to be made of hard wood agreeable to his invention, and the wedges of various angles. The horizontal wedges of the first block were nine degrees; of the second, seven; and of the third, five; of course, the angle of the vertical wedge of the first block was 162 degrees; of the second, 166; and of the third, 170. These blocks, or wedges, were well executed, and rubbed over with soft soap for the purpose of experiment. They were then placed in a dock, in his majesty's yard, at Plymouth, in which a sloop of war was to be docked: on examining them af-

ter the vessel was in, and the water gone, they were all found to have kept their situations, as placed before the ship rested upon them. Shores in their wake were then erected to sustain the ship, prior to the said blocks being taken from under the keel. The process of clearing them was, by applying the power of battering-rams to the sides of the outer ends of the horizontal wedges; alternate blows being given fore and aft; by which means they immediately receded, and the vertical wedges were disengaged. It was observed, even in this small ship, that the block which was formed of horizontal wedges of nine degrees, came away much easier than those of seven, and the one of seven than that of five. In removing the aforesaid blocks by the power of the battering-rams, which were suspended in the hands of the men employed, by their holding ropes passed through holes for that purpose, it was remarked by Mr. Seppings, that the operation was laborious to the people; they having to support the weight of the battering-rams, as well as to set them in motion. He then conceived an idea of affixing wheels near the extremity of that part of the rams which strikes the wedges. This was done before the blocks were again placed; and it has since been found fully to answer the purpose intended, particularly in returning the horizontal wedges to their original situations, when the work is performed for which they were displaced; the wheels also giving a great increase of power to the rams, and decrease of labour to the artificers; besides which, the blows are given with much more exactness. The same blocks were again laid in another dock, in which a two-decked ship of the line was docked. On examination they were found to be very severely pressed, but were removed with great ease. They were again placed in another dock in which a three-decked ship of the line was docked. This ship having in her foremast

and bowsprit, the blocks were put quite forward, that being the part which presses them with the greatest force. As soon as the water was out of the dock, it was observed that the horizontal wedges of nine and seven degrees had receded some feet from their original situations. This afforded Mr. Seppings a satisfactory proof, which experience has since demonstrated (though many persons before would not admit of, and others could not understand, the principle), that the facility of removing the blocks or wedges, was proportionate to the quantity of pressure upon them. The block of five degrees kept its place, but was immediately cleared, by applying the power of the battering-rams to the sides of the outer ends of the horizontal wedges. The above experiments being communicated to the Navy Board, Mr. Seppings was directed to attend them, and explain the principle of his invention; which explanation, further corroborated by the testimonials of his then superior officers, was so satisfactory, that a dock was ordered to be fitted at Plymouth under his immediate directions. The horizontal wedges in this, and in the other docks, that were afterwards fitted by him, are of cast iron, with an angle of about five degrees and a half, which, from repeated trials, are found equal to any pressure, having in no instance receded, and, when required, were easily removed. The vertical wedge is of wood, lined with a plate of wrought iron, half an inch thick. On the bottom of the dock, in the wake of each block, is a plate of iron of three quarters of an inch thick, so that iron at all times acts in contact with iron.

The placing the sustaining shores, the form and sizes of the wedges, and battering rams, &c.; also the process of taking away, and again replacing, the wedges of which the block is composed, are also exemplified by a model.

The dock being prepared at Plymouth, in August,

1801, the Canopus, a large French 80-gun ship, was taken in, and rested upon the blocks; and the complete success of the experiment was such, that other docks were ordered to be fitted at Sheerness and Portsmouth dock-yards, under Mr. Sepping's directions. At the former place a frigate, and at the latter a three-decked ship, were suspended in like manner. This happened in December, 1802. and January, 1803; and the reports were so favourable, as to cause directions to be given for the general adoption of these blocks in his majesty's yards. This invention being thought of national consequence, with respect to ships, but particularly those of the navy, government has been pleased to notice and reward Mr. Seppings for it.

The time required to disengage each block is from one to three minutes after the shores are placed: and a first-rate sits on about fifty blocks. Various are the causes for which a ship may be required to be cleared from her blocks, viz. to shift the main keel; to add additional false keel; to repair defects; to caulk the garboard seams, scarples of the keel, &c. Imperfections in the false keel, which are so very injurious to the cables, can, in the largest ship, be remedied in a few hours by this invention, without adding an additional shore, by taking away blocks forward, amid-ships, and abaft, at the same time; and, when the keel is repaired in the wake of those blocks, by returning them into their places, and then by taking out the next, and so on in succession. The blocks can be replaced in their original situations, by the application of the wheel battering-rams to the wedges, the power of which is so very great, that the weight of the ship can be taken from the shores that were placed to sustain her. There were one hundred and six ships of different classes, lifted at Plymouth dock-yard, from the 1st of January, 1798, to the 31st of December, 1800;

and, had the operation of lifting taken less time, the number would have been considerably increased; for the saving of a day is very frequently the cause of saving a spring tide, which makes the difference of a fortnight. The importance of this expedition, in time of war, cannot be sufficiently estimated.

This invention may be applied with great advantage, whenever it is necessary to erect shores, to support any great weights, as, for instance, to prop up a building during the repair of its foundation, &c. Captain Wells, of his majesty's ship Glory, of 98 guns, used wedges of Mr. Sepping's invention for a fid of a top-gallant mast of that ship. In 1803, the top-gallant masts of the Defence, of 74 guns, were fitted on this principle by Mr. Seppings: and, from repeated trials, since she has been cruizing in the North Sea, the wedge fids have been found in every respect to answer.

But it is Mr. Sepping's wish that it should be understood, that the idea of applying this invention to the fid of a top-gallant mast originated with captain Wells, who well understood the principle, and had received from him a model of the invention.

When it is required to strike a top-gallant mast, the top ropes are hove tight, and the pin which keeps the horizontal wedges in their place is taken out, by one man going aloft for that purpose; the other horizontal wedge is worked in the fid, as shown in the drawing and model that accompany this statement. The upper part of the fid hole is cut to form the vertical wedge. The advantage derived from fidding top-gallant masts in this way is, that they can be struck at the shortest notice, and without slacking the rigging, which is frequently the cause of springing and carrying them away, particularly those with long pole heads. The angle of the horizontal wedges for the fids of masts should be about twenty degrees.

The above account was accompanied with certificates from sir John Henslow, surveyor of the navy; Mr. M. Didram, master-shipwright of Portsmouth-yard; and Mr. John Carpenter, foreman of Sheerness dock-yard, confirming Mr. Sepping's statement.

Reference to the Engraving of Mr. Sepping's method of obviating the necessity of lifting ships. Plate 10.

This plan and section of a seventy-four gun ship describes the method of obviating the necessity of lifting ships, when there may be occasion to put additional false keels to them, or to make good the imperfections of those already on; also, when it may be necessary, to caulk the garboard seams, scarples, the keel, &c.; by which means a very considerable part of the expense will be saved, and much time gained. The blocks are cleared, and again returned by the following process. A sufficient number of shores are placed under the ship to sustain her weight, and set taught, stationed as near the keel as the working of the battering-rams fore and aft will admit. Avoid placing any opposite the blocks, as they would in that case hinder the return of the wedges with the battering-rams. A blow must then be given forward on the outer end of the iron wedges with the battering-rams in a fore and aft direction, which will cause them to slide aft, as shown in the plan. The battering-rams abaft then return the blow, and the wedges again come forward; by the repetition of this operation, the wedges will be with great ease cleared, and the angular block on the top will drop down. When the work is performed, the block must be replaced under the keel, and the wedges driven back by working the rams athwart-ships, as described in the section.

N. B. In returning the iron wedges, to avoid straining the angular blocks, it is proposed to leave a few of

them out forward and aft, and stop the ship up, by laying one iron wedge on the other, as shown at Fig. 1, Plate 10.

To facilitate the business, blocks may be cleared forward and aft at the same time, sufficient to get in place one length of false keel. If the false keel should want repairing, it may be done without any additional shores, by clearing one block at a time; and when the keel is repaired in the wake of that block, return the wedges, as above directed, and clear the next, &c.

Section and Plan, Plate 10, Fig. 2.

A, Keelson.

B, Ceiling.

C, Floor timber.

D, Dead or rising wood.

E, Plank of the bottom.

F, Keel and false keel.

G, Angular blocks with a half-inch iron-plate bolted to them.

H, Cast-iron wedges.

I, Iron-plate of three-fourths of an inch thick on the bottom of the dock.

K, Battering-rams, with wheels, and ropes for the hands.

L, Cast-iron wedges, having received a blow from forward.

M, Shores under the ship to sustain her weight.

Fig. 3, represents part of a top-gallant mast fitted with a wedge fid.

a, Top-gallant mast.

b, Fid, with one horizontal wedge worked on it.

c, Moveable wedge, with the iron strap and pin over it, to keep it in its situation.

d, Trussel trees.

Mr. Seppings Method of suspending Ships.

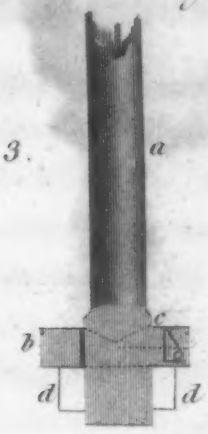


Fig. 3.

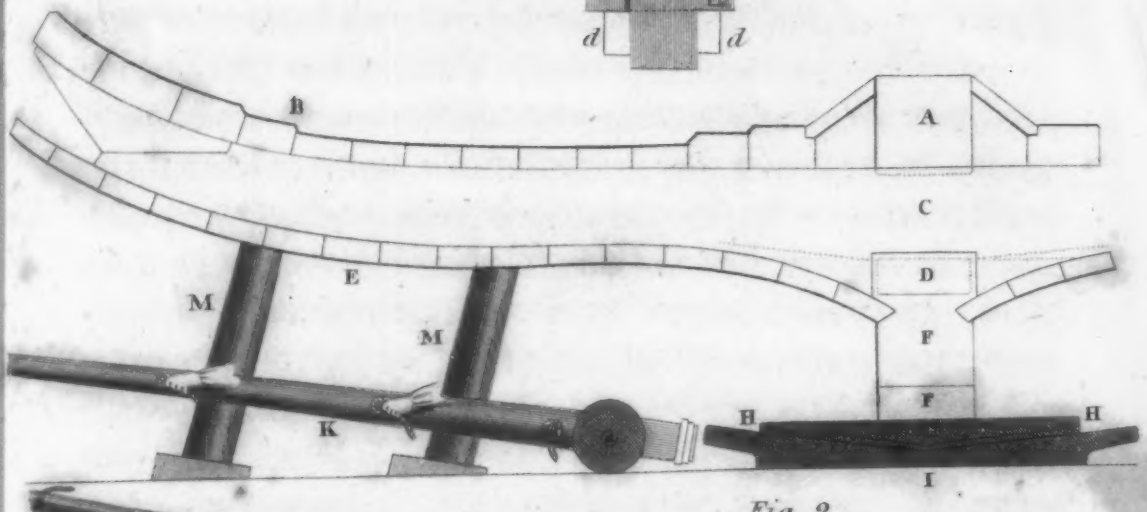


Fig. 2.

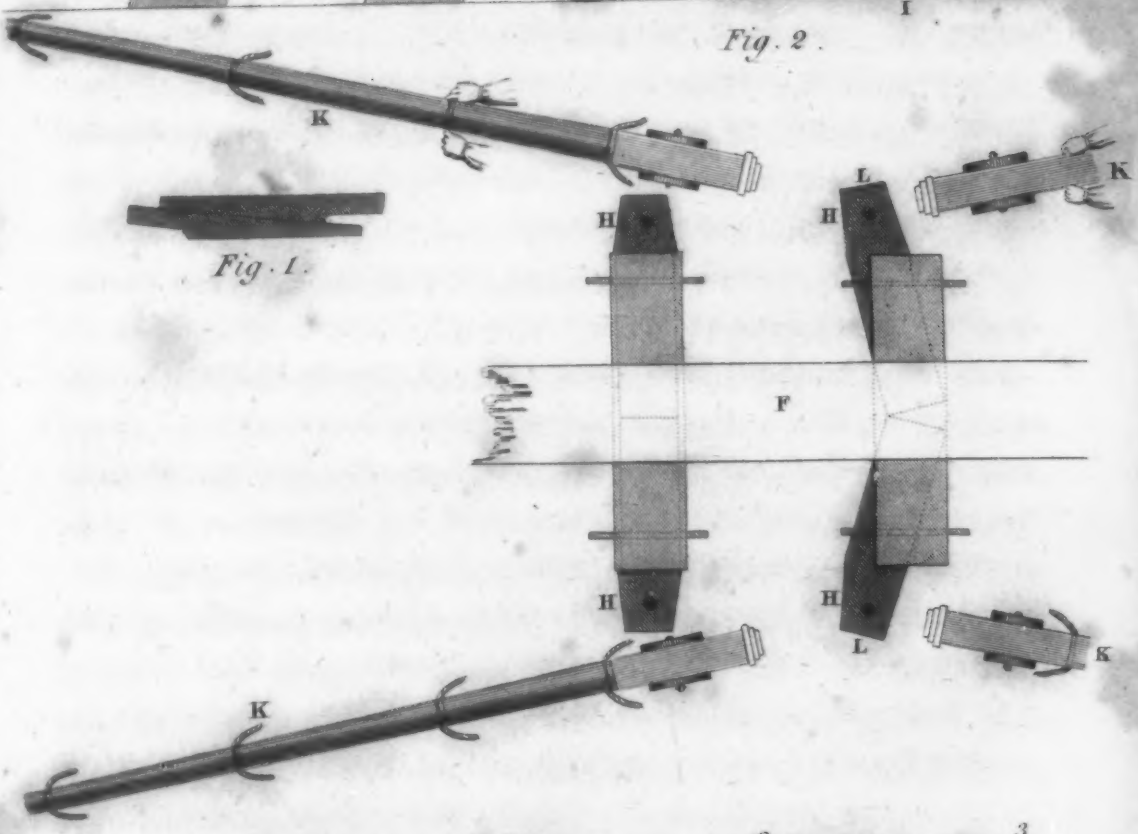
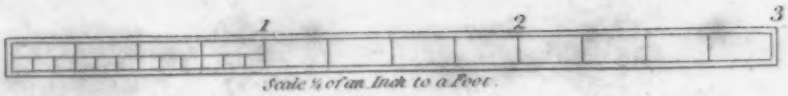


Fig. 1.



Scale ½ of an Inch to a Foot.

Emporium of Arts & Sciences Vol. I. pl. 10.

C. Tiebout.

No. 46.

On the irregularity in the rate of going of Time-pieces occasioned by the influence of Magnetism. An original Communication, by Mr. VARLEY, dated May 31, 1798.*

HAVING studied the theory of clock and watch-making many years, as well as been, part of that time, concerned in an extensive manufactory of watches, I have had many opportunities of observing a circumstance which has surprised every one in the trade as well as myself; that watches of considerable price, and from the hands of excellent workmen, often perform no better than a plain one of inferior workmanship and much lower price. Being anxious, as may naturally be supposed, to furnish my friends with watches or clocks which would go well, I made it my business to pay particular attention to whatever could contribute to their perfection. With this view, I made almost numberless experiments and observations on the various escapements now in use, the different constructions of balances, pendulums, pendulum springs and compensations, both for clocks and watches, which have been applied by very ingenious mechanics and excellent workmen to correct the errors in the rate of going, especially of watches, occasioned by the various degrees of heat and cold, change of position, external agitation, influence of oil, friction, variation of maintaining power, and other causes.

Some of these contrivances are extremely well adapted to answer the intended purpose; but, notwithstanding all their advantages, the maker and purchaser are frequently disappointed in the performance of the machine to which they are applied. Many instances might be

* Tilloch, vol. 1. p. 16.

produced where the best workmen have been employed, no expense spared by the maker, and the above-mentioned improvements applied with the utmost care and attention; and yet the rate of going of the watch has been more irregular than in some ordinary watches. When such a circumstance occurs, it is extremely unpleasant: the purchaser not understanding the difficulties which the maker has to encounter, thinks himself ill used, and the latter suffers at the same time in his reputation as an artist, and in his character as a man; and when the watches happen to have been made for nautical purposes, or for exportation, the whole community, in some measure, become sufferers.

The intention of the present paper is to point out a defect in the construction of time-pieces of every description in which balances are used, and at the same time a source of error in their performance, which has been hitherto little if at all suspected, but which, where it occurs, completely defeats all the ends intended to be answered by the application of the above-mentioned ingenious contrivances: and that it does occur very frequently, will be made sufficiently obvious by a simple detail of facts supported by actual experiments.

That the balances of watches, when manufactured of steel, as they mostly are, might be in a small degree magnetic, and consequently have some influence in disturbing their vibrations, has been suspected by some and denied by others: but that a circular body, such as a balance is, should possess polarity; that a particular point in it should have so strong a tendency to the north, and an opposite point an equal tendency to the south, as to be sufficient materially to alter the rate of going of the machine when put in different positions, has never, I believe, been even suspected. If it had, the use of steel balances would have been laid aside long ago, particularly where

accurate performance was indispensible, as in time-pieces for astronomical and nautical purposes. Though I have frequently examined, with great care, watches that did not perform well, even when no defect in their construction or finishing was apparent, and suspected the balance to be magnetic, yet I never could have imagined that this influence, operating as a cause, could produce so great an effect as I found upon actual experiment; for I did not expect to find that a balance, even when magnetic, should have distinct poles. Happening to have a watch in my possession, of excellent workmanship, but which performed the most irregularly of any watch I had ever seen, and having repeatedly examined every part with particular attention, without being able to discover any cause likely to produce such an effect, it put me upon examining whether the balance might not be magnetic enough to produce the irregularity observed in its rate of going.

I took the balance out of its situation in the watch, and, after removing the pendulum spring, put it into a poising tool, intending to approach it with a magnet, but at a considerable distance, to observe the effect, while at the same time the distance of the magnet should preclude the possibility of the magnetic virtue being thereby communicated to the balance. I had no sooner put it into the tool than I observed it much out of poise; that is, the one side appeared to be heavier than the other: but, as it had been before examined, in that particular, by a very careful workman, more than once, I was at a loss to determine what to think of the effect I saw; when happening to change the position of the tool upon the board, the balance then appeared to be in poise. As there could be no magic in the case, it appeared that the balance had magnetic polarity, as no other cause could produce the effect I had witnessed, and which was repeated as often

as I chose to move the tool from the one position to the other. It happened that I was then sitting with my face to the south: a circumstance that led me, in placing the plane of the balance vertically, to put it north and south, and of course the axis east and west—the only position in which the magnetic influence could make itself most apparent, and which will account for the circumstance not having been observed by the workman who examined the poise of the balance before I did; for, as often as I placed the plane of the balance vertically between east and west it was in poise, whichever end of its axis was placed towards the south.

Having pretty well satisfied myself as to the cause, I now proceeded to determine the poles of the balance. With that view I placed its axis in a vertical situation, and of course its plane was horizontal; and I was much surprised to find that, in that position, it possessed sufficient polarity to overcome the friction upon its pivot; for it readily turned on its axis to place its north pole towards the north. Making a mark on that side that I might know its north pole, I then repeatedly turned that point towards the south; and, when left at liberty, it as often resumed its former position, performing a few vibrations before it quite settled itself in its situation and came to rest—exactly as a needle would do if suspended in the same manner.

I was extremely happy that I had observed these effects before I brought a magnet to make the experiment I first intended, as I might, and as others also might have concluded, that the polarity had been produced by the approach of the magnet. I now, however, brought a magnet into the shop, and, presenting its south pole to the marked side, that is, to the north pole of the balance, the balance continued at rest; but upon presenting the north pole to the marked place, it immediately receded

from the magnet, and resumed its former position whenever the magnet was withdrawn.

No doubt now remaining as to the facts, and being in possession of the position of its poles, I proceeded to examine the effects produced by this cause upon the watch's rate of going. Having put on the pendulum spring, and replaced the balance in the watch, I laid the watch with the dial upwards, that is, with the plane of the balance horizontally, and in such a position that the balance when at its place of rest should have its marked side towards the north:—in this situation it gained 5′ 35″ in twenty-four hours. I then changed its position so that the marked side of the balance when at rest should be towards the south, and, observing its rate of going for the next twenty-four hours, found it had lost 6′ 48″—producing, by its change of position only, a difference of 12′ 23″ in its rate. It must be obvious to every person, that even this difference, great as it was, would be increased or diminished as the wearer should happen to carry in his waistcoat pocket a key, a knife, or other article made of steel. This circumstance, taken along with the amount of the variation occasioned by the polarity of the balance, was fully sufficient to produce all the irregularity observed in the going of the watch.

I then took away the steel balance, substituted one made of gold, and, having brought the watch to time, observed its rate of going, and found it as uniform as any watch of the like construction; for, though it was a duplex escapement, which is perhaps the best yet invented, at least for common purposes, it had no compensation for the expansion and contraction occasioned by heat and cold, and therefore a perfect performance was not expected.

Steel balances being commonly in use, and, on that account, easiest to be procured, and being on many ac-

counts preferable to any other, I was unwilling to abandon them entirely; but resolved to take the precaution of always trying them before I should apply them to use. The mode I adopted was, to lay them upon a slice of cork sufficient to make them float upon water, and I was in hopes that out of a considerable number I might be able to select sufficient for my purpose; but to my surprise, out of many dozens which I tried in this manner, I could not select one that had not polarity. Some of them had it but in a weak degree, and not more than one or two, out of the whole quantity, appeared to have it so strong as the one which gave birth to these experiments and to the present paper, which is perhaps more prolix than could be wished: but the subject appeared to be not uninteresting, and I hope the remarks I have offered will not be altogether useless, as every thing that can tend to add to the perfection of time-pieces, or to remove any cause that operates against their perfection, is of some importance.—&c. &c.

S. VARLEY.

No. 47.

Description of a Camp Telegraph, invented by KNIGHT SPENCER, *Esq. Secretary to the Surry Institution.**

SIR—The important advantages resulting to the naval service from the introduction of the telegraph by sir Home Popham, now universally adopted, are too well known to be here insisted upon.

That telegraphic signals have been productive of great advantages to land armies, for more than 3000 years, is very easily proved.

* Tilloch, vol. 36. p. 321.

That *the most important advantages have resulted* to the French arms, from the use of the telegraph, in the present age, is too well authenticated to be doubted.

That commanders of British armies have felt the absolute necessity of adopting some mode of telegraphic communication, is proved by the late campaign in Sicily, and the present campaign in Spain.

That many attempts have been made to introduce the telegraph into our land-service universally, cannot be questioned.

To what cause, then, is it to be attributed, that to the present moment this powerful instrument remains to British armies (generally speaking) nearly a useless invention?

The only *rational* answer to this question seems to be, that, hitherto, no practicable system has been offered, and the attempts to introduce it must, probably, have failed;—either, from the intricacy of the machines, or, the difficulty of transporting them into situations where they could be used.

Whatever cause may have hitherto retarded its introduction, it will hardly for a moment be contended, that, were a telegraph produced as certain in its operations as the present fixed telegraph, and at the same time so simple and portable as to require no separate establishment, either for its transport or management, it would not be a most important acquisition in the field.

With this conviction on my mind, I have endeavoured to obviate the supposed difficulties; and the result, which I call my CAMP TELEGRAPH, I request permission to lay before the public through the medium of your respectable Magazine;—indulging the hope, that it may meet the attention of those who have sufficient influence to bring the subject fairly under the consideration of his majesty's government. Perhaps it may not be improper

to state, that my invention has already been honoured with the approbation of several general and other officers very capable of forming correct opinions on the subject;—and that I have frequently asked a question with it at the distance of *six miles*, and have received an answer within *three minutes*. Any officer of ordinary capacity will be able, after two hours' application, to direct a station; any private will perform the duty of a signal-man after half an hour's drill; and, the apparatus not being more cumbrous than a serjeant's pike, there seems no necessity whatever for a separate establishment to manage it.

Explanation.

To work the Camp Telegraph, which is *numerical*, the director of each station must be assisted by three privates or others, to be called signal-men; one of whom must be furnished with a staff 13 or 14 feet high, on which must be mounted two flexible balls, about three feet diameter, as described below:—this is called the *centre-point*. The other two signal-men must each be furnished with a staff ten feet high, mounted with one flexible ball.

The signals must be made by one or both of the signal-men taking an ordered number of paces to the right or left of the centre-point; in the rear of which the director takes his stand, during the time of making communications.

All signals must be made by order of the director of the station, who must give the word for the necessary number of paces. These are to be taken by the signal-men, in *double-quick time*, carrying their balls at the trail; and when they have arrived at the point or points ordered, the balls must be instantly elevated.

All signals must be repeated by the corresponding sta-

tion; and when the director of the station making the communication, observes this is done, he gives the word "*Down,*" and his signal-men must then retire in double-quick time to the rear of the centre-point, carrying their balls at the trail. The word "*Down*" must likewise be given by the director of the station *receiving a communication,* the instant he observes the signal-men at the corresponding station begin to retire.

A. (Plate 11.) Is the signal of *communication,* and is made by placing one of the signal-men at 20 paces to the right, and the other at 20 paces to the left, of the centre-point.

B. Is the signal of a *point or period,* and is to be made at the close of a number, as 275, by placing one signal-man three paces to the right, and the other three paces to the left, of the centre-point.

C. Is the signal of *error,* and is to be made when your correspondent has mistaken your last signal:—Suppose you had made the signal No. 2, which is 20 paces to the right, and your correspondent answers with 20 paces to the left, which is the signal No. 7. Then make the signal of error, by placing one signal-man three paces to the left, and the other 10 paces to the right of the centre-point; and when your correspondent has repeated this signal, thereby convincing you he is sensible of his error, *repeat the signal that had been mistaken,* and, if rightly answered, proceed as before.

D. Is the *repeating* signal, and is to be made if the last communication is not understood. It is made by placing one signal-man three paces, and the other 20 paces, to the left.

Numerals.

No. 1. Is made by placing one signal-man three paces to the right of the centre-point.

No. 2. By placing one signal-man 20 paces to the right.

3. By placing one signal-man 10 paces, and one 20 paces, to the right.

4. By placing one signal-man at three, and one at five paces, to the right.

5. By placing one signal-man at 18, and one at 20, paces to the right.

6. By placing one signal-man three paces to the *left* of the centre-point.

7. By placing one signal-man 20 paces to the left.

8. By placing one signal-man 10, and one 20, paces to the left.

9. By placing one signal-man at three, and one at five, paces to the left.

0. By placing one signal-man at 18, and one at 20, paces to the left.

The flexible ball is constructed in the following manner:

Take an ash or deal staff of the required length, and the substance of a stout pike. Take twelve whalebones, four feet six inches long, and fix them at nine inches from the top of the staff, in the way the whalebones of umbrellas are fixed:—fix the lower ends of these whalebones to a strong slide (like the slide of an umbrella), the pipe of which must be 18 inches long, and project upwards. To the top of this pipe, stretchers 18 inches long must be affixed, and also to the middle of each whalebone, like the stretchers of an umbrella, to keep the ball stiff when in use. There must then be a strong umbrella-spring fixed on the staff, at three feet from the upper fastenings of the whale-bones, or top of the ball, so that, when the slide is pushed up, the whale-bones will form a sphere of three feet diameter.

The skeleton of the ball being thus prepared, it is to be covered with glazed linen, half black and half white, divided *vertically*. Letter G is a drawing of the skeleton of the ball, but only showing two whalebones instead of twelve. When the balls are not in use, they will be unsprung, and covered with strong cloth cases.

Signals by Night.

To make these, it will require two lamps, about nine inches square and 12 inches high, to be elevated, one above the other, at the distance of three or four feet, for the centre-point: and one lamp for each signal-man, to be fixed on the top of the ball-staff.

Each lamp must have two hollow lenses, about four inches diameter, filled with different-coloured transparent fluids—(say pale green and pale red),—which will distinguish them from common lights. They must be suspended upon a pin, put through a strong iron frame, resembling the frame of a sign which is fixed upon an upright sign-post, so that when the staff is raised they will swing perpendicularly; and when they are carried at the trail, they will still be in a perpendicular position.

The reservoir for the oil must be made like those for the agitable lamps; the wicks must be flat, and about one inch broad.

E. is a front view of the lamp for night signals.

F. is a side view of the same.

A code of numerical signals, and a numerical vocabulary applicable to the land service, arranged upon the plan of Sir Home Popham's for the naval service, will be necessary.

When a tent or any other object is fixed upon as a centre-point, it is then generally unnecessary to use the double ball.

When stations are taken *below the horizon*, the white

sides of the balls are to be turned to your correspondent, and it is advantageous to have the men in white or fatigue dresses.

When stations are taken *above* the horizon, the black sides are to be turned towards your correspondent, and then it is advantageous to have the men in uniform.

I am, sir, your obedient servant,

KNIGHT SPENCER.

Surry Institution,
Nov. 6, 1810.

No. 48.

Invention of a Homograph, or Method of Communication by Signals, on Sea or Land. By LIEUTENANT JAMES SPRATT, *of the Royal Navy.**

SIR—With this you will receive a truly ingenious invention of Lieut. James Spratt, of the Royal Navy. This gallant officer, in the glorious action of the combined fleet at Trafalgar, on the 21st of October, 1805, was on board his majesty's ship Defiance. When engaged within pistol shot with a French eighty-gun ship called l'Aigle, he plunged into the sea, swam to the enemy's stern, and entered the gun-room port alone, made his way courageously through the different decks, and succeeded in mounting the enemy's poop, where placing his hat on the point of his cutlass, he called out to his men to join him. In attempting to haul down the French colours, he was attacked by several of their grenadiers, whom he repulsed with success. He was soon followed by several of our jolly tars, and in the act of saving the life of a French officer who cried out for quarter, a musket was

* Nicholson, vol. 25. p. 325. Transact. of the Society of Arts, vol. xxvii. p. 163. The silver medal was voted to Lieut. Spratt for this invention.

levelled by a Frenchman at his own breast, which he fortunately struck downwards, but his leg was fractured by the shot; he afterwards fought two of the enemy on his knees, who were quickly dispatched by his companions, and the French ship soon after struck. More particulars of this transaction are recorded in the XV volume of the Naval Chronicle, page 193. I have the pleasure to add, that Lieut. Spratt, after a tedious illness, has recovered the use of his leg, and now has the command at the signal post at Teignmouth, anxiously wishing to be again employed in more active service against the enemies of his country.

I have taken the liberty of sending this communication, and the account of his invention, unknown to him, knowing that the Society of Arts &c. is generally disposed to encourage merit in every rank and situation wherever found. M. S.

This new, easy, and useful code of signals is to be performed with a white pocket-handkerchief, to be held in different positions with the body. Plate 11, fig. 1, A, with the dotted lines, exhibits the whole of the numeral homograph signals at one view, (see the positions that the handkerchief is held in, and the figures marked). The first position from the right foot to the right hand is No. 1, the others No. 2, 3, 4, 5, 6, 7, 8, 9, and 0, follow in succession. When making 1, 5, 9, and 0, the handkerchief should be held by the diagonal corners, as generally prepared for wearing round the neck.

For making 2, 3, 4, 6, 7, 8, the opposite sides of the handkerchief should be gathered in each hand, the near extremity of the handkerchief to be held by one hand to the point of the shoulder.

In working the homograph the body should be erect, the positions steady, the handkerchief to be held well in

front of the arms, and facing the person to whom you are to impart your intentions.

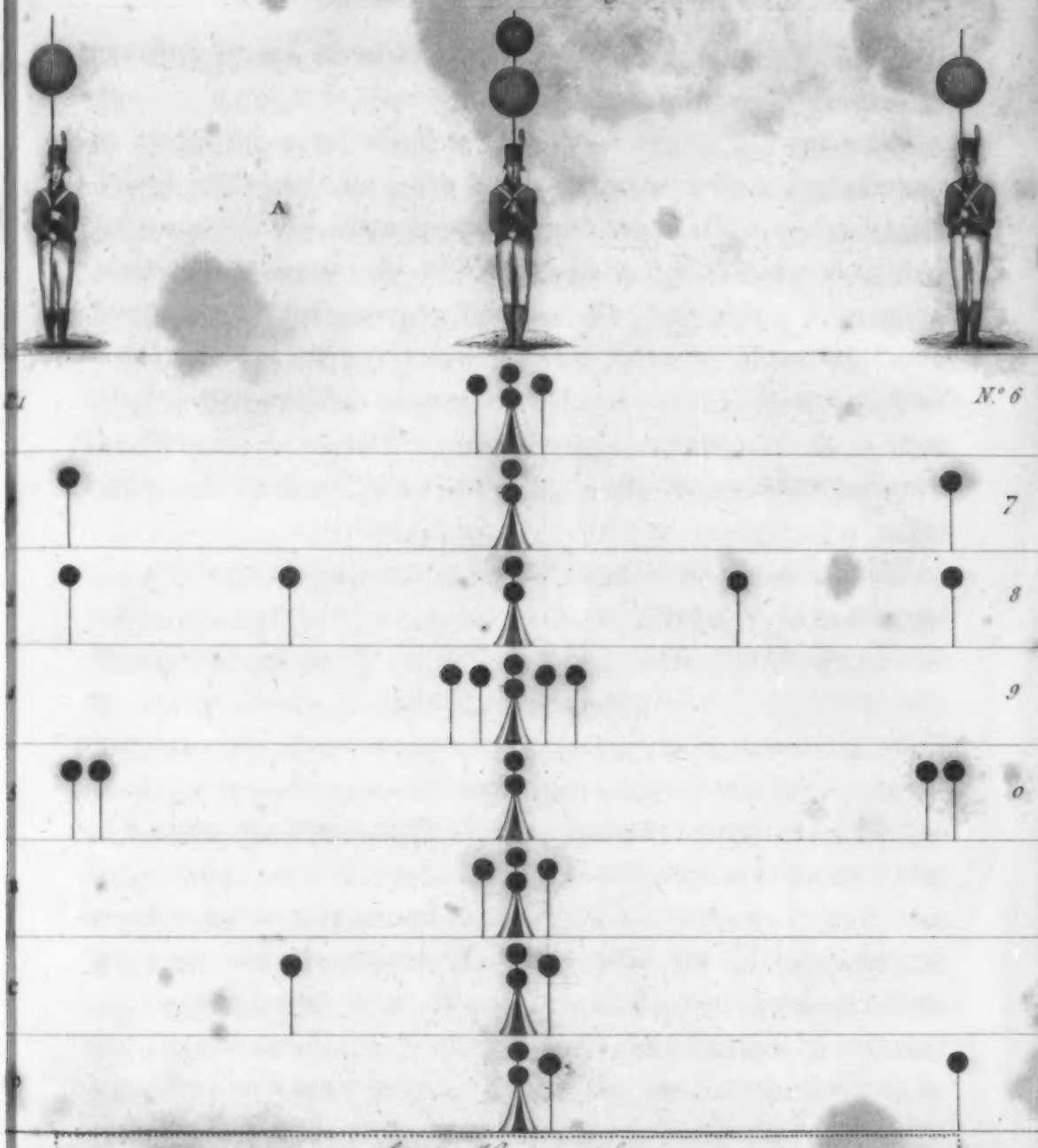
The best place for showing signals from a ship is in the chains, or on a lower deck port, as the white handkerchief exhibits a greater contrast with the black sides, and is of course better discerned. When on shore, they should be made from the side of a green hill, or in front of some thick foliage, or hedge, or dark wall.

The positions intended to compose the number of signals should be made in succession. The person, to whom a signal is made, should wave his handkerchief horizontally, to convince you that it is understood.

When the positions which compose the number of your signals are finished, you are to wave your handkerchief in like manner. For example, persons who make use of the homograph should arrange in their separate books, or from a telegraphic dictionary, every question and answer, which may occur to them on any subject, as there is no limitation to the numbers. If the number affixed to your communication be 1000, you are first to make position No. 1, and keep it so until your consort answers it by waving his handkerchief, which informs you that it is understood; then you are to make the 0 three times distinctly, as shown at figure A, each 0 to be kept up until answered as before. Now your signal being made, wave your handkerchief, which informs your consort, that he is to refer to his book for the purport of the signal No. 1000, which may either refer to a distinct word in dictionaries numbered alike, or to a whole senctence in conversations, premeditated and inserted in books formed for the purpose.

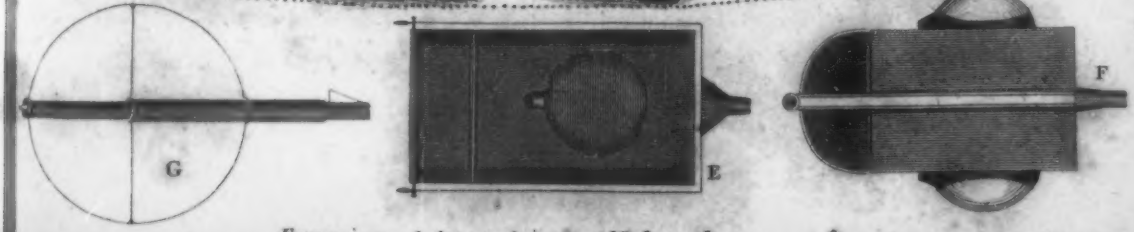
When you wish to commence a communication by signals, you are to display the handkerchief in the manner shown at fig. B, which is called the signal of attention, and your consort is to display his in return. The per-

Spencer's Camp Telegraph.



Spratt's Homograph

Fig. 1.



Emporium of Arts & Sciences Vol. I. pl. II.

son who displays first has a right to begin the communication, and to prevent confusion, it is to be displayed at the commencement of every signal.

If by any accident your attention should be called off, and you did not comprehend the whole of a signal, by holding the handkerchief as in fig. C, you may demand a repetition. This signal is called the repeat. Fig. D, shows the following signals, by twisting the handkerchief regularly round one of the arms, and holding it in one of the positions marked 1, 2, 3, 4, viz. No. 1, affirmative; No. 2, negative; No. 3, interrogative; No. 4, to annul.

Sir—I acknowledge the receipt of your letter respecting my homograph, and beg leave to express the high sense I entertain of its having been noticed by so distinguished an institution as that of the Society of Arts, &c. I am positively the first inventor of it, and I put it in execution at the commencement of this war, on board his majesty's ship Defiance, commanded by P. C. Durham, who did me the honour to express his approbation of it, and promised to bring it to the notice of his royal highness the duke of York; but having the honour of getting a fractured leg in the battle of Trafalgar, I was prevented from getting attention to my homograph.

I have frequently conversed in this manner with my messmates at Spithead, from the green ramparts at Portsmouth, and from Plymouth Sound to the Hoe, which is still a greater distance. The conversation may be carried on at the distance of four miles by a common telescope.

The various uses to which the homograph may be applied at any moment, without expense, will not fail to attract the notice of persons of discernment. In active military service it will be found very important. It will be

found useful to naval captains lodging on shore, who may thus communicate any orders with ease and accuracy to the commanding officers of their ships at anchor. Passengers on board ships in fleets may keep up a constant and friendly intercourse, to console themselves for the tediousness of a long voyage; and the country gentleman may, at a moment's warning, summon his neighbours to the sports of the field, or to the hospitable board.

If my homograph should meet with the approbation of the Society of Arts, &c. and tend to the good of the community at large, I shall be highly gratified.

I have the honour to be, &c.

JAMES SPRATT.

Teignmouth Signal-Post,
Dec. 26th, 1808.

The following Certificates were received from Lieut. Glanville, R. N.; Lieut. Tayler, R. N.; Mrs. Spratt, of Burlington-House; and Miss Taylers, daughters of the mayor of Devizes.

I do hereby certify, that being at Ryde in the Isle of Wight in the summer of the year 1806, I frequently conversed with Lieut. Spratt, by means of the homograph invented by him; and previous to the battle of Trafalgar, Lieut. Spratt conversed in this way with many officers at Gibraltar. I also certify, that I have heard from officers of the Brest, Cadiz, and Mediterranean fleets, that Lieut. Spratt was the inventor, and the first person who made use of such invention. Given under my hand this 10th day of Jan. 1809.

J. N. TAYLER,
Lieut. of his majesty's ship Spencer.

We the undersigned do hereby certify, that being at Ryde in the Isle of Wight in the summer of the year

1806, we did frequently see Lieut. Spratt of the Royal Navy conversing from the shore, by means of the homograph invented by him, with Lieut. J. N. Tayler, then on board his majesty's ship the Leopard, lying at Spithead. Ann Tayler further saith, that she with many others saw it used with great success at Teignmouth.

Witness our hands, Feb. 2d, 1809.

MARY TAYLER,
ANN TAYLER,
MARGARET SPRATT.
} Devizes, Wilts.

This is to certify, that I, George Glanville, Lieut. of the Royal Navy, saw Lieut. Spratt, then master's mate of the Defiance, conversing by means of a homograph from the ship Defiance, with Lieut. Nicholas on board the Malta, six or eight months previous to the Trafalgar action, and that they seemed perfectly to understand each other by the signals given.

Witness my hand this 30th day of May, 1809,

GEORGE GLANVILLE, Lieut. R. N.

No. 49.

Improvement of Nooth's Apparatus; in a letter from Dr. Wilkins of Baltimore, dated August 12, 1812.

(With a Plate.)*

DEAR SIR—The use of artificial Mineral Waters having become very general in our large cities, both as a medicine and luxury, the inhabitants of smaller places, and the country, seem very desirous of having a method of preparing them. The costliness of the large apparatus

* The engraving will be given in the next number.

used here, is a barrier to their general use; and the waters drawn off into jugs soon become flat and insipid, with every precaution. Nooth's apparatus, which is very elegant, has been laid aside on account of the great danger of breaking it: almost every one introduced into use, has soon met with its fate, under the greatest precautions. In nineteen cases out of twenty the machine has been broken by the air being obstructed in the valve, which is both complex and difficult; of course a contrivance that would give a free discharge to any quantity of air, that might be emitted from the ingredients, would at once remove the great cause of damage, as well as simplify the operation. I herewith communicate to you a plan, that I think simple and effectual, which may re-introduce that machine, and if with this, the precaution be used to keep the vitriolic acid ready diluted for use, and a small guard-board be made over the superior stopper, that it may play, but not spring out, there will then remain no danger but what is common to all glass; and it will be as rare to hear of one being broke, as it is now to hear of one being sound. A great number of those imported are at first defective in the valve, which will never be the case in this way; and of course can be sold at a lower price. For better understanding the plan, I send you a drawing, though I will first describe the apparatus and method of fixing it.—A silver or glass siphon, not less than one eighth of an inch in the bore, making a contracted arch so as to occupy little more room than a double tube, is made to pass through the bottom of the middle part of the machine, and there fix the extremity of its longest leg, thus communicating (when set up) with the lowest part; then passing up beyond the highest water mark (an inch or more) it returns quite down to the apex of the same piece of the machine, and discharges the air at the bottom of the water. A little

nozle may be fitted on with many apertures in it (as in a water pot) to divide the stream of air; or a small piece of gause or silk of very loose texture may be tied on in form of a globular bag at the end. Such a piece will be necessary even over the nozle, tied at a small distance in advance: for when water is forced into the superior part of the machine, as is frequently the case, it stands above the arch of the * siphon, and if at that time the pressure from below relaxes by the absorption or escape of air and the cessation of discharge, the pressure from above would be liable to force some of the water through the siphon into the lower part of the machine; this will be prevented by the little bag before mentioned, pressing into the tube, or applying itself over the holes in the nozle, but would never, if properly put on, and sufficiently open, obstruct the air coming out, as it would then be distended. It would be advisable to have about two inches of the long end of the siphon separate, and cemented into the lower part or place of the old valve, as a receptacle, and fitted there, that the rest might be removed and cleaned (if silver), and if the siphon is made of glass, it would be best to have a silver receptacle. Many old machines with bad valves or none, may be repaired by passing the long leg of such a siphon through a cork, and fixing it in the old aperture for the valve: some might prefer this method in new machines, and have a glass stopper at that part to receive the siphon (as shewn in the plate.) This would be more costly and liable to accident, though somewhat easier to introduce the siphon. In the other plan it must be introduced above, with a pair of forceps. Water may be impregnated in a much shorter

* This elevation of water will often return, if the upper stopper is very tight, and the bent tube attached to the upper part of the machine is so long as to enter the main body of water. It would therefore be as well to have it something shorter, in new made machines.

time than in the old way, by the air passing so freely, as it does through the siphon.

Fig. 1, Pl. 12. View of Nooth's Apparatus, with the siphon valve—the syphon rising above the water mark.

Fig. 2. *a*, Part of the siphon cemented in, as a receptacle. *b*, Perforated stopper, for the place of the old valve.

No. 50.

List of American Patents.

(Continued from page 237.)

1798.

Nathan Read, Jan. 8, machine for cutting and heading nails.

Thomas Bruff, senior, Jan. 8, improvement in grinding coffee.

John Dixey, Jan. 24, machine for printing paper, leather, &c.

Isaac Tryon, Feb. 22, improvement in cutting and pointing comb-teeth.

Charles Holden, March 15, improvement in wind-mills.

Samuel Blydenburg, March 22, machine for dipping candles.

Robert M'Kean, March 24, steam saw-mill.

Aaron Clarke, March 30, mill for sawing boards.

Elijah Ormsbee, March 21, screw engine for throwing water.

John Manning, April 10, improvement in raising water from fountains.

John Martin, April 27, regulating the action of the tide on his spiral wheel.

Mark Isambard Brunel, April 27, machine for raising water.

Isaac Lazell, May 18, machine for removing rocks, &c.

James Smallman and Nicholas J. Roosevelt, May 31, a double steam engine.

Thomas C. Martin, June 2, machine for threshing wheat, &c.

Charles Stoudinger, June 2, machine for propelling vessels.

Walter Brewster, June 7, water-wheel flume for large streams.

Jonathan Hunt, June 7, an oblique pump.

John Love, June 11, " a tallow lamp."

Samuel Cooley, June 6, a composition for pills.

John W. Godfrey and W. Lane, July 14, improvement in stoves.
R. Peale, Dec. 14, method of preserving vessels, &c. from worms.
William Banks, December 14, improvement in making bread.
David Wilkinson, December 14, machine for cutting screws.
Cyrus Austin, Dec. 14, improvement in manufacturing paper.
Mark Reeve, Dec. 14, pipes and pumps for conveying water.
S. Colver, Dec. 14, machine for clearing docks and harbours.
S. Colver, Dec. 14, machine for heaving down vessels, raising weights, &c.

1799.

Joseph Huntley, Jan. 10, machine for raising water.
Mark I. Brunel, Jan. 17, machine for writing with two pens.
Thomas Thompson, Jan. 3, method of regulating wind-mills.
Seth Hart, Jan. 4, machine for making nails.
John Sears, Jan. 24, machine for manufacturing salt.
Henry Abbot, Jan. 24, improvement in a coal stove.
E. Spooner, Jan. 25, machine for cultivating corn, beans, &c.
Eliakim Spooner, Jan. 25, machine for planting corn, beans, &c.
E Reed, Feb. 14, improvement in a horizontal water-wheel.
Benjamin Dearborn, Feb. 14, improvement in steelyards.
B. Du Val, Feb. 14, preparation of steel for cutting glass.
Jacob Perkins, Feb. 14, improvement in making nails.
Benjamin Tyler, Feb. 26, a flax and hemp mill.
William Hancock, Feb. 26, improvement in casting iron.
Charles Whiting, March 2, extracting oil from cotton seeds.
John Shotwell, March 16, improvement in sharpening axes, &c.
Jacob Perkins, March 19, a check to detect counterfeits.
Josiah Shackford, March 21, improvement in propelling boats.
Isaac Sandford, March 27, machine for dressing cloth.
Samuel Morey, March 27, obtaining force from water by steam.
Phineas Pratt, April 12, machine for making combs.
Samuel Morey, April 24, improvement in his water engine.
B. Dearborn, April 30, double-centered mill for wind or water.
Andrew W. Duty, May 8, new method of cutting clay for tiles.
William Farris, May 17, machine for raising water.
C. Gould, May 27, " machine to keep a ship's distance at sea."
M. Wigglesworth, June 26, improvement in making ropes.
Samuel H. P. Lee, June 26, " bilious pills."
Ezra Weld, June 26, improvement in washing clothes.
James Long, Aug. 5, napping hats.
Richard Robotham, Aug. 14, purifying spermaceti oil.

Samuel Eli Hamlin, Aug. 30, a capstan fire-engine.

Moses M'Farland, Oct. 28, federal balloon.

Robert R. Livingston, Oct. 28, manufacturing of paper.

Apollos Kinsley, Oct. 28, universal pump.

Daniel Keller, Nov. 5, boat for descending rapid streams.

John Stickney, Nov. 29, pumps for ships, mines, &c.

Thomas Payne, Dec. 2, saw-mill.

John G. Gebhard, Feb. 4, extracting oil from Palma Christi.

John Hawks, Dec. 14, Hawks' pills.

Havilard Chase, Dec. 16, improvement in mills.

J. Pitman, Dec. 24, "effeminate ropery for spinning rope-yarn."

1800.

Oliver Evans, Jan. 16, improvement on stoves and grates.

S. Gorham, Feb. 4, machine for spinning rope yarn and twine.

S. Constant, Feb. 4, composition to preserve wood, brick, &c.

B. Bolitho, Feb 7, machine for pounding rice, gunpowder, &c.

W. Shotwell, Feb. 7, metal boxes for wood or iron to turn in.

John J. Hawkins, Feb. 12, improvement in piano fortes.

Hattil Killey, 2d, Feb. 12, method of covering salt vats from the weather.

Nathaniel Ladd, Feb. 12, extracting the essence of sumach, fera, &c. for tanning.

Patrick Lyon, Feb. 12, engine for throwing water.

James Cox, Feb. 20, raising or lifting hides in tanning.

Benjamin Tyler, Feb. 20, improvement in grist mills.

John Percy, March 3, improvement in dying blue.

William Harris, March 15, lathe or loom for weaving.

C. Hoyt, jun. April 7, machine for manufacturing sumach.

William Hottensteen, April 10, improvement in coach collars.

Peter Walker, April 10, stop cock.

Dean Howard, April 10, improvement in the manufacture of boots and shoes.

Silas Stone, May 6, improvement in the elastic truss for ruptures.

John Biddis, May 6, engine for reducing silk, cotton, worsted, cloth, &c. to their original state, to be manufactured.

Simeon Jocelin, May 8, silent moving time-keeper.

Jeremiah Brown, May 14, improvements in the construction of ships and vessels.

George Hadfield, May 15, machine for making bricks and tiles.

Edward West, May 19, metal amulets.

T. O. Harrison, May 19, machine for splitting hides and skins.

Robert Smith, May 19, mould board of a plough.

William Shotwell, June 24, cogs, &c. for pullies.

Peter Lorillard, June 28, machine for cutting tobacco.

James Deneale, jun. July 10, kiln for drying grain.

Peter Lossing, Aug. 4, improvement in burning lime, &c.

Frederick Butler, Aug. 22, machine for cooking.

Frederick Young, Aug. 23, machine for cutting and heading nails.

Jonathan Kilborn, Aug. 23, machine for cutting tanner's bark.

David Cooley, jun. and Gabriel N. Philips, Aug. 25, improvements in chimneys.

Ezra Weld, Sept. 17, "Lavater," machine for washing and wringing clothes.

Richard Mansfield, Oct. 24, improvement in manufacturing bricks.

Aaron Brookfield, Oct. 24, raising water for mills.

John J. Hawkins, Oct. 24, improvement in musical instruments.

Jonathan Grout, jun. Oct. 24, telegraph (description) filed.

Samuel Murray, Nov. 17, obtaining force from water, with the assistance of steam.

William Young, Nov. 20, hanging windows without weights.

1801.

John Cannon, Jan. 17, machine for breaking flax.

Jesse Wheaten, Jan. 17, jaundice bitters.

Ebenezer Whiting, Jan. 22, cotton gin.

Henry Guest, Jan. 26, improvement in sheathing vessels.

Alexander Anderson, Jan. 26, brewing with Indian corn.

Do. Jan. 28, condenser for heating wash in distilling.

Joseph Strong, Jan. 29, axle tourniquet.

William Henderson, Feb. 12, improvement in the construction of stoves.

Thomas Bedwell and Benjamin Henfrey, Feb. 12, improvement in evaporation.

Michael Garber, Feb. 20, machine for making and heading nails.

Barnabas Langdon, Feb. 20, hydraulick machine for raising water.

David Grieve, Feb. 20, improvement in boats to ascend rivers, &c.

Benjamin Henfrey, March 2, increasing the surface of evaporation for the purpose of distilling.

Richard Weems, March 16, boring machine for posts for fencing.

William Stillman, March 16, veneering plough for cabinet work.

John Strong, March 24, hydraulick engine.

Israel Hatch, March 24, making and discharging chain and cleaver shot.

Nathan Kent, May 1, cut nails from iron hoops, &c. rendered tough.

David Ellicot, May 1, stove, screw, and reel grain drying machine.

Solomon Thayer, June 9, impellent pump.

Jesse Reed, June 9, nails milled out of heated rods.

Samuel Downing, June 12, extract of bark for dying, &c.

John Eveleth, June 13, forcing pump.

Charles W. Peale, July 16, portable vapour bath.

Henry Guest, July 16, infusing oil into leather, &c.

Jeremiah Ladd, July 17, a beaming machine.

Caleb Green, July 23, mill for grinding painter's colours, &c.

Christopher Hoxie, Aug. 20, machine for extracting grain from straw, &c.

William Palmer, Aug. 25, a machine for raising water.

Gurdon F. Saltonstall, Aug. 21, improvement for cooling and conveying up meal, &c.

Gurdon F. Saltonstall, Sept. 2, metallick fluted gin rollers, for cleaning cotton.

Thomas Bruff, Sept. 14, manufacturing spoons.

James Sharples, Sept. 15, giving motion to wheels within cylinders.

Do. mechanical powers for the use of wind-mills, &c.

Thomas Power, Sept. 19, manufacturing potash.

Samuel Willis, Sept. 21, moveable suspended beam and scale.

Richard Robothom, Oct. 10, air-pump ventilator for ships, mines, &c.

Richard Robotham Oct. 10, machine for ruling paper, &c.

John Poole, Oct. 13, a syphonick steam machine.

Michael Krafft, Oct. 28, construction of stills.

William Leslie, Nov. 5, machine for cutting and heading nails.

John A. Morton, Dec. 16, improvement in a windmill.

George Clymer, Dec. 22, improvement in a ship's pump.

Jos. Condit, jun. Dec. 28, making paper from currier's shavings.

1802.

Joseph Hutton and Gideon Fairman, Jan. 8, improvement in the art of engraving.

Rufus Hathaway, Jan. 20, improvement in a wind-mill.

Simon Willard, Feb. 8, improvement in a time-piece.

Isaac Baker, Feb. 20, a machine for churning.

Thomas B. Whilock, Feb. 23, improvement in boxes for carriages.

Richard Claiborne, Feb. 23, improvement in paddles for propelling boats.

Nathaniel Robbins, March 11, improved mode of carrying fish in warm weather.

Jacob Warrel, March 17, machine for cutting and grinding bark.

John Biddis, March 22, manufacturing starch from potatoes.

John W. Holly, March 27, improvement in a grist mill.

Moses Coates, April 1, improvement in a saw mill, which returns the log after each cut.

Ebenezer Whiting, April 1, improvement on a block macking gang-lathe.

William Bell and Samuel de Montmollin, April 7, machine for ginning cotton.

Joel Pierce, April 10, machine for churning.

Benjamin Henfrey, April 16, improvement, being a cheap mode of obtaining light from fuel.

Samuel Downing, April 19, extracting the essence of bark for dying.

Asher Spicer, April 22, machine for cleaning clover seed.

Hezekiah Richardson, jun. and Levi Richardson, April 28, improvement in a saw mill.

Henry Abbott, May 4, machine for rolling iron round, &c.

Do. improvement in casting close stoves.

Henry Johnson, May 10, improvement in flat roofs for houses and balconies.

Burgiss Allison, May 12, mode of improving spirits.

Lewis du Pré, May 12, scientific steelyards.

Benjamin Ellicot, May 12, machine for manufacturing salt.

Andrew Law, May 12, new plan for printing music.

Nicholas Young, May 14, machine for cutting fur for the use of hatters.

Edward West, July 6, machine for cutting nails.

Do. improvement in heading and cutting nails.

Do. improvement in a gun lock.

Do. improvement in a steam boat.

Jacob Perkins, July 9, improvement in pumps.

Stephen Stilwell, July 9, machine for cleaning wheat.

John Greenleaf, July 13, machine for cleaning out docks.

Jesse Reed, July 15, method of rolling iron for nails.

Ezekiel Miller, July 19, improved machine for threshing and cleaning wheat.

Ezekiel Miller, July 17, machine for making bricks.

Martin Miller, July 19, machine for cleaning clover seed.

Joseph Pope, July 22, machine for threshing grain.

Thomas H. Rowson, July 24, antibilious pills.

Nathan Forbes, Aug. 2, machine for making nails.

James Templeton, Aug. 17, improvement in a trigonometrical quadrant.

William Paine, Aug. 24, improvement in a still.

Elisha Putnam, Aug. 24, improvement called a fire-stop.

Nicholss Boureau, Aug. 30, economical house and ship steam kitchen.

Matthew C. Groves, Sept. 3, astronomical quadrant.

Benjamin S. Walcott, Sept. 4, machine for heading nails.

Leonard Kennedy, Sept. 7, improvement in fastening, in raising and supporting window sashes.

John Richardson, Sept. 13, an evaporating furnace.

Jacob Idler, Sept. 24, machine for pressing cotton or other bale goods.

Samuel Briggs, jun. Oct. 9, improvement in a steam engine.

John Baptiste Aveilhé, Oct. 14, machine for raising water, [a perpetual motion!!!]

Asa W. Chickering, Nov. 29, improvement in splitting skins.

Benjamin Gorton, Nov. 29, improvement in extracting neutral salts from alkaline.

John Gardiner, Dec. 3, improvement in erecting dry docks.

William Caruthers, Dec. 13, machine for making nails.

James Cowen, Dec. 14, improvement in the construction of mill wheels.

John Staples, Dec. 15, improvement in stills.

Valentine Peers, Dec. 18, improvement in making salt.

Timothy Kirk, Dec. 28, improvement in a boiling cistern.

Simon Lozarus, Dec. 21, antibilious stomach cordial.

Daniel Pettibone, Ezekiel Chapman, and Josiah Nicols, Dec. 22, improvement in the manner of welding cast steel to iron, &c.

Abraham Du Buc Marentille, Dec. 23, an insubmersible boat.

Burgiss Allison and John Hawkins, Dec. 30, improvement in manufacturing paper from corn husks.

William Palmer, Dec. 31, machine for sawing stone and marble.

*List of English Patents.**

(Continued from Page 237.)

1796.

John Luke, Esq. July 4, machinery for lifting, drawing, and conveying loaded and light vessels from one canal to another.

Valentine Close and James Keeling, July 5, improvements in ovens, kilns, and firing-places; firing, hardening, and baking, porcelain and earthen wares, &c.

Gabriel Aughtie, July 20, a coffin, so secure, as to render it impracticable either to break, cut, or otherwise open it.

Robert Hoakesly, July 20, making British potash, for all kinds of manufactures in which foreign potash, or any alkali, is useful.

Henry Walker, July 20, method of erecting houses, &c. in one entire mass or body.

Thomas Potts, July 20, machine attached to the stern of any vessel, boat, or barge, for moving it.

Charles Haley, Aug. 17, marine timekeeper, for the better ascertaining the longitude at sea.

Samuel Guppy, Aug. 19, method of cutting and heading nails, whereby much labour is saved.

Arnold Wilde and Joseph Ridge, Aug. 25, method of making saws, and divers other articles, of iron and steel united, also of iron or steel.

Francis Lowndes, Sept. 9, machine for exercising the human body.

Thomas Cooper, Sept. 9, machine for mashing or mixing malt, for the purpose of brewing or distilling, by means of which both a vertical and horizontal motion is produced.

Ralph Wedgwood, Oct. 3, method of making earthen ware, whereby that article may be made at a less cost than hitherto.

Ralph Wedgwood, Oct. 3, composition for making glass upon new principles.

Ralph Wedgwood, Oct. 3, stove upon a new principle.

John Pepper, Oct. 3, mode of building ovens and kilns, for firing and burning of china, earthern ware, bricks, tiles, and other earths and compositions.

Edward Thomason, Oct. 25, steps for coaches, chariots, &c.

John Steedman, Oct. 31, machine for threshing corn.

Edmund Lloyd, Oct. 31, teakettle or teaboiler on a new construction, boiling water more expeditiously, and at much less expense.

* Repertory, vol. 7.

John Russel, Nov. 5, an apparatus, named *Selenographia*, to exhibit the phenomena of the moon.

John Davidson, Nov. 7, machine for doubling, twisting or making, reeling, and skaining, worsted, thread, silk, cotton, &c. which requires only one person to work, manage, and direct.

William Raley, Nov. 10, horizontal turning churn, which is easily worked, collects the butter sooner, and is easier kept clean, than those in common use.

Thomas Cobb, Nov. 19, method of making coloured paper, which may be used as well for hanging rooms, as for writing, printing, drawing, &c.

Charles Trusted, Nov. 24, machine called a time-repeater, to be applied to common watches, for the purpose of striking the hours and quarters.

William Jackson, Dec. 5, improvement upon doors, whereby the door shuts of itself, without noise.

James Tate, Dec. 5, machine for cooking, on improved principles.

John Gover, Dec. 8, carriage for all sorts of cannon, whereby the working and management of them may be done with less difficulty and labour.

Francis Lloyd, Dec. 13, furnace or fire-place calculated to save expense in fuel.

Moses Lafount, Dec. 23, a plate and hoop or band, to be used in mounting glass chandeliers, &c.

1797.

John Lee, Jan. 23, mixture of chalk, whiting, or lime, together with clay, loam, or earth, for colouring and making bricks.

Dudley Adams, Jan. 23, spectacles upon a new principle, by which all pressure is removed from the temples and nose.

Anthony George Eckhardt and Richard Morton, Jan. 23, making candlesticks, &c. so that the lights may be raised or lowered, having likewise the advantage of an extinguisher.

Timothy Sheldrake, Jan. 24, method of curing the deformities of children, or others.

Robert Ferryman, Jan. 24, machine for blanching, grinding, and dressing of corn.

James Murphy, Jan. 27, improvements in tanning hides and skins, &c.

William Rolfe and Samuel Davis, Jan. 31, improvements in harpsichords and piano-fortes.

George Cotes, Jan. 31, machine for expediting the making of horse-shoe nails, brads, &c.

John Grover, Feb. 7, improvements in the construction and fixing of coppers, boilers, and furnaces.

John Falconer Atlee, Feb. 7, method of condensing and cooling spirits, in the process of distillation.

James Glazebrook, Feb. 7, method of working and giving power to machinery, by means of air.

John Nash, Feb. 7, method of constructing bridges of plate-iron, &c.

Aaron Garlick, Feb. 7, machine for spinning and roving of cotton.

Nicolas Dubois Dechemant, Feb. 15, table with a stove placed in the centre thereof.

INTELLIGENCE.

English Incendiary Fusees Examined.

The commandant in chief of the isle of Oleron, general De Grave, transmitted to the Society of Encouragement at Paris, an incendiary fusee, about a demimetre long, found on board of an English boat, which was wrecked on the coast of France. The society directed its committee of chemical arts to analyse the same; and M. Gay Lussac, in the name of the committee, made the following report on the 2nd of August, 1809.

The fusee which I examined was not entire; it was about three decimeters long, and its internal diameter did not exceed a centimeter. The envelope was formed of several folds of grey paper, pasted on each other, and the whole covered with a coat of oil paint, to resist moisture. The inflammable matter which it contained, had a grayish yellow colour, in which particles of sulphur were easily distinguishable; on being lighted, it burned with a vivid flame about a decimeter and a half long, exhaling a very strong odour of sulphurous acid. The duration of its combustion was from ten to twelve minutes, for a length of three decimeters of the fusee. Having pulverized the inflammable matter, I treated 30.78 grammes with water; the matter which did not dissolve after repeated washings, weighed 7.690 grammes; it consisted of a mixture of sulphur and charcoal. I then treated this mixture with caustic potash, and obtained 0.504 grammes of charcoal; deducting this from the weight of the mixture, I deduced that of the sul-

phur, and concluded, that 100 parts of the fusee were composed of 75 nitre, 1.6 charcoal, 23.4 sulphur.

Having thus determined the nature and proportions of the elements of the fusee, I endeavoured to make a similar one. For that purpose, I took a cylindrical stick of a centimeter diameter, around which I rolled a sheet of grey paper, impregnated with a little glue. I then withdrew the stick; and when the envelope was sufficiently dry, I closed one end with a cork, (*bouchon de liége*) which entered with some difficulty. The envelope thus prepared, I made a mixture in the proportion above indicated, and having reduced it to a hard paste by a little water, I introduced the same into the cylinder, compressing it strongly with a musket ramrod. When the dissication of the mixture was completed, I lighted it; the phenomena which it presented were precisely similar to the English fusees. It burns in a similar manner, with deflagration, and in the same time, as the society may convince themselves by those which I have the honour of presenting to them.

Arch. des Decouv. de 1810.

PRESERVATION OF BUTTER.

One part of sugar, one part of nitre, and two parts of the best Spanish salt, are to be finely pulverized together, and kept for use; one ounce of this is to be mixed thoroughly with 16 ounces of the butter, as soon as it is freed from the buttermilk; it is then to be put into a close and perfectly clean dry vessel, from which the air is to be carefully excluded, and it will remain good for many years.

Johnson's *Animal Chemistry*, vol. 1. p. 149.

ENGLISH CHEESE.

According to Parkinson, the Stilton is made of the curds from sour and sweet milk mixed together, and the whey pressed lightly out; and the richness depends in some measure on the quantity of cream. It is afterwards turned often, and not dried too quickly. Cheshire cheese is made of new milk, and its rich flavour and mellowness are owing to an addition of sweet beef suet, or any other, which is poured into and mixed with the curd, with a sufficient quantity of salt to keep it from rancidity. It is found that the hotter any kind of cheese is put together, the sounder it will be; and the colder you put it together, the richer it is, and the sooner it will decay.

Idem, vol. 1. p. 155.

R. Edwin sc.

Sir Isaac Newton

Born Dec.r 25th 1642. – Died March 20th 1727.

Emporium of Arts & Sciences